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Mineral Development in Ontario North of 50°

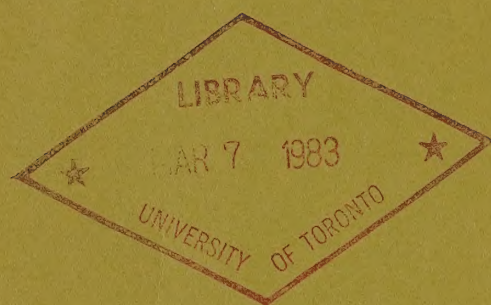
Technical Paper #4

Gold

Dr. H. Strauss
and
Dr. E. T. Willauer

the ROYAL COMMISSION on the
NORTHERN ENVIRONMENT





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LAURENTIAN UNIVERSITY

1981

This technical report provides background material for the final report Mineral Development in Ontario North of 50°, submitted to the Royal Commission on the Northern Environment by Laurentian University in September, 1982.

However, no opinions, positions or recommendations expressed herein should be attributed to the Commission; they are solely those of the authors.

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INTRODUCTION

Purpose, Organization and Scope

The purpose of the following analysis is to point out that the gold mining industry will undergo a period of transition over the next ten years as the price of gold has left its fixed moorings to become flexible in both directions. The new market situation represents a daring opportunity for gold mining in Canada and, especially, in Ontario to regain some of the loss in stature as a world gold producer. In this process, however, the gold mining industry has to face strong competition from other gold producing countries which is carried on in an atmosphere of an unprecedented price uncertainty. Eventually, the gold mining industry will have to rely to a very large degree on a relatively small number of industrial uses as the main consumption base which supports the demand for gold.

This study is organized in the following way: Section I briefly discusses properties, qualities and occurrences of the metal, while Section II investigates the nature of gold consumption in the world and in the United States. It also surveys the distribution of the existing gold stock in the world. The output of the gold mining industry in the world is analyzed in Section III with special reference to the roles played by Canada and Ontario on the world scene. This section also scrutinizes the changes in importance of the world's main gold suppliers

since 1950 and it tries to shed some light on the more recent happenings in the area of Canadian gold exports and imports. World ore reserves and the positions and prospects of eight alternative main gold suppliers is explored in Section IV while the history of the price of gold is discussed extensively in relation to the world monetary systems in Section V. Section VI concludes the report by presenting the more rigorous scientific results of the econometric forecast of future gold prices and production within reasonable limits of an unusually unstable model.

The main period for analysing prices and production involves the years 1950 to 1979, although the more general discussions of the development of prices and the accumulation of gold stocks extend further back into history. Aspects of consumption, ore reserves and details of Canadian external trade in gold are viewed in a much shorter time reference framework.

Summary of Findings

The fact is that gold does not corrode or decay and any newly mined gold must add to the existing stock of gold in possession of men. One half of the total mined gold stock is accounted for and in the hands of monetary authorities and private individuals and institutions. The distribution of the other half remains unassessed. There is no doubt that this slowly growing gold stock in the hands of a very large number of

economic units will make itself felt in the daily performance of the gold price in the gold commodity market.

Among the four most important gold producing countries the picture of the United States of America and Canada - and Ontario for that matter - has been the worst over the last twenty years whereas that of South Africa and of the Soviet Union has been the best.

In the foreign trade sector, Canadian gold exports and imports give the clear impression that Canada imports more in gold alloys from other countries than it exports to them in the form of ore, concentrate or metal. In the year 1979, Canada imported substantially more of gold alloys in terms of value added than it exported. The gold reimports even make the circuit via the Soviet Union.

With a known global gold reserve of about 60,000 metric tons, the mine supply will sustain production for another fifty years, reaching an output of 1,200 to 1,300 metric tons annually by the year 2000. Eventually, the annual rate of gold output will decline even if new discoveries occur in the meantime.

After over one hundred years during which period the price of gold had been held fixed, it is now free to fluctuate and subject to the vicissitudes of the gold market. Prone to react to changes in the world political climate, it responds quickly to signals emanating from an unstable world financial system

which could be its nemesis if managed imprudently. This price will return to an economically conditioned trend rising from \$300 per ounce to \$400 per ounce during the early 1980s, measured in 1979 constant U.S. dollars. Later in this decade it will probably rise towards the \$700 per ounce mark. It is around these trends that the daily price of gold will gyrate. Unfortunately, the econometric model does not permit any further reasonable glance into the future of the price of gold because the model breaks down on account of an unusual negative relationship between the price and the annual quantities supplied. As concerns the future production of gold around the year 2000, this unstable model gave a long-run underestimate. When adjusted for outputs of previously excluded countries and for extraordinary future production potential of a small number of countries, the obtained figure did not contradict an independently arrived value based on observation and personal judgment.

To all these conclusions has to be added the first observation that the preference for gold in consumption is of smaller significance the wealthier the country in terms of real income and the availability of consumer goods. This observation was made when comparing a basic North American pattern of consumption with that of other countries.

General Conclusions

The foregoing analysis invites the following conclusions. The world gold mining industry is in a period of transition from a market situation characterized by certain and fixed prices to one of price flexibility and uncertainty. Under the former system costs of production were rising whereas prices did not change. This brought about a rising output as mining operations became more efficient in the mining of a quality ore sufficient to recover expenditures. With the onset of upward moving gold prices ores of lower grade became minable and a general decline in output was noticeable above all in the U.S.A., Canada and, especially, in the Province of Ontario. This would not have occurred had the price of gold never been fixed.

Under the latter where prices are now flexible the mining industry will, in time, face a normal price supply relationship. The high prices will lead to the expansion of mining activities in existing gold mines, the opening of new mines and the re-opening of those which had to be closed.

Simultaneously, a great price uncertainty hangs over this market as never before. These fluctuations will turn out to be larger than is customary for the other metals analyzed in the course of this study. However, this high degree of variability of prices will not last forever, because the time will come - and this point may lie more than ten years in the future - that the

basic negative unstable relationship between price and quantities supplied responsible for the abnormal behaviour will have changed into a normal lasting one. Then an increase in price will entail an increase in mining output. This would also mean that the relative amplitudes of the gold price swings will become smaller than currently is the case.

As the production side to the market becomes more competitive, efforts will be directed towards continuous improvement of financial management and control as well as towards technical improvements of gold mining operations.

For the very large number of holders of an increasing world gold stock the demand picture has also undergone a fundamental change. A long expected and overdue large upward adjustment in the price of gold has taken place brought about by the general increases in the world price levels. As long as the price of gold remained fixed or rose less than proportionately to the rate of inflation, a gold price increase could be expected which meant that gold was a good investment, a hedge against inflation. This price explosion had its day and the holders of gold can only expect to benefit from further price increases in proportion to the rate of inflation. If one considers, however, that the rate of interest can be higher than the rate of inflation, the wealth holders do not gain by having their deposits invested in another form of money which is gold which does not bring any interest.

Therefore, the intensity of gold consumption for investment purposes will be lower than prior to the price explosion of the years 1979/1980. Also, gold wealth holders will have to live in a world in which they are much more vulnerable to downwards movements in the price than ever before. It is difficult to see that they would, in large number, try to unload their large holdings in an attempt to drive the gold price down. Nor can one expect individual large holders, e.g. the Soviet Union try to ruin the price of gold. This could only hurt all of them in their own position as final wealth holders. In essence, they are bound together by a bond of community of interest and purpose: a high price of gold. Only the speculators and traders in the gold market may influence the daily prices with the sole purpose to have and hold: more wealth.

Under the present conditions, these trading operations may entail a destabilizing performance in the market. Let us not forget that the industry is selling in this market and that it may utilize the forward market especially if the price is favourable.

Over the long run of ten years and more, the basic instability of the gold market may have given way to one of normal stability.

In the final analysis, the production of the gold industry is determined by the amount of gold consumed industrially. These quantities will rise more or less proportionately with the

rise in world incomes and production. The greater the real rate of growth, the greater the demand for gold, the smaller the rate, the lower the consumption. It has to be recognized that it is only a small and limited number of industrial uses, i.e. in jewelry, dentistry and electronics, which will provide the mining industry with the basic reason for its existence for many years to come. The Canadian gold mining industry has a great opportunity to regain part of the significance it lost as a world gold producer, but this opportunity has to be seized with greater circumspection than ever before because: the price is on the move in both directions! With an expanding gold mining industry the country may benefit again from being a gold producer whereas recently the national benefits of this important industry, when looking at the balance of payments effects of gold have been open to serious doubt, mildly speaking.

*

SECTION I: THE METAL

If there is a metal which has occupied the minds of men like no other through all ages in history, it is gold. It is a metallic element, and of yellow colour.¹ It occurs free in nature but is widely dispersed either unevenly in the rock crust of the earth or more homogenously though very sparsely in the waters of the seven seas.² In the crust of the earth gold is invariably found in alloyed form with silver or copper, and sometimes bismuth, mercury and other metals. It is known to occur in mineral deposits called pyrites which contain, beside the natural iron sulfides, copper, nickel, platinum, silver and other metals.³ When found in particular locations as so-called 'native gold' the mineral has been known to contain up to 99.8 percent of gold although the general rule for nuggets and similar gold particles lies in a range between 85 percent and 95 percent of gold content. This includes occurrences in alluvial deposits and quartz veins. Ontario gold reserves consist of both native and polymetallic ores.

Gold has several properties. Besides being one of the heaviest substances known, it is soft, ductile, and scarce. These qualities account to some degree for the attractive spell which this metal has cast upon most of mankind over its entire history. Its aesthetic attractiveness explains its use in

jewelry, and to some degree, in dentistry. Limited oxidization assures that it does not depreciate. Aesthetic beauty, scarcity and non-perishability, combined with monetary qualities has made it a means for storing value. Gold has been, though variably through the ages, a means of payment. In particular, it has been the international standard of world finance. Attempts to demonetize gold have always resulted in the reaffirmation of its world monetary stature. Unquestionably, it is the sine qua non of confidence for any currency or currency standard. This holds true especially when an international financial system is involved. Paper gold - the other and original name for 'Special Drawing Rights' (SDRs) - is nothing but an imperfect substitute for the yellow metal as concerns financial credibility and confidence.

The softness of gold has made it one of the most pliable and malleable of all metals. A small quantity of well-refined gold can be hammered or rolled into very thin foil. The most impressive demonstration of this quality of gold may be found on the visitors' gallery on top of the Trade Centre in downtown Manhattan. There, on this high structure of world trade is written a short history of gold⁴ with numerous exhibits of gold substances including a large square footage of foilage wrought of one ounce of gold.⁵

Malleability combined with the property of being the most ductile of all natural metals⁶ has led to increased usage of

gold filaments in electronics and computer technology. Many of the modern computer chips contain such fine gold wires.

As much as there are substitutes for gold in the jewelry and dental fields, it is no surprise that gold has substitutes and alternates in electronics. For instance, base metals covered with gold alloys find increasing use in electrical and electronic products and save on gold. In general, platinum, silver and palladium are such substitutes.⁷

SECTION II: CONSUMPTION

Three main aspects of the demand for gold will be considered at this juncture. They are (a) the world gold consumption for the years 1975-1978, (b) the industrial consumption of gold in the United States of America for the years 1964-1978 including private investment which has become possible since 1975, and (c) world gold holdings and their distribution for the year 1978.

World Gold Consumption

Consumption of gold for the year 1975 in the world as a whole amounted to 36 million troy ounces. In the following year, this volume had risen to 46.7 million troy ounces, an increase of 29.7 percent. This may be compared to a rise in the world GDP index (without services) of 6 percent, indicating, at first sight, a considerable income elasticity. In the following year, 1977, consumption increased to 51.7 million troy ounces, which is equivalent to a rise of 10.7 percent. Still, the responsiveness to world GDP was substantial as GDP recorded a rise of 4.7 percent. In the following year, however, world consumption of gold rose by only 2.5 million ounces to 54.2 million ounces, or by 4.8 percent. This compares with an increase of roughly 4.5 percent in world GDP.

Within this relatively small number of years, initial large changes of consumption of gold in relation to changes to income slowly decreased to the same rate of increases in world output. This variability indicates the existence of a strong price relationship to consumption, as well as to expectations concerning the future of gold prices.

It is in Table 1 that the basic historical statistics are presented. It gives not only the above-mentioned values, but also the distribution of gold consumption for the world as a whole by the two main types of use and their components. The two main uses are: industrial and financial.

Industrial Consumption

The industrial demand for gold in the world amounted to 64.2 percent of the total demand of 36 million troy ounces in 1975 compared to 74.2 percent in 1978 as 54.2 million ounces of gold were absorbed by industry. The years in between saw a relatively sharp rise in industrial consumption which is explained by a substantial increase in the component use for jewelry. As Table 1 clearly indicates, its consumption increased from 64.2 percent in 1975 to 81.8 percent in 1976. Therefore, the overall increase in world consumption between these two years is mainly due to the rise in the jewelry use.

TABLE 1

World Gold Consumption and
Percentage Distribution by Type of Use
for the Years 1975 to 1978

	1975	1976	1977	1978
Total Quantity used (millions of troy ounces)	36.0	46.7	51.7	54.2
Type of Use Distribution (%)	%	%	%	%
<u>Industrial</u>	64.2	81.8	77.8	74.2
Jewelry	46.1	64.2	60.9	58.1
Electronic	5.6	4.9	4.4	4.3
Dentistry	5.5	5.2	5.1	4.8
Other Industrial	5.0	4.3	4.3	4.1
Medals	2.0	3.2	3.1	2.9
<u>Financial Holdings</u>	35.8	18.2	22.2	25.8
Official coins	21.7	12.6	8.5	11.8
Private Holdings (Hoarding, Speculation, Investment)	14.1	5.6	13.7	14.0
Total	100.0	100.0	100.0	100.0

Source: American Metal Market, Metal Statistics, 1979,
Fairchild publ. N.Y., New York, p. 107.

With jewelry the main component of the industrial uses of gold, the other three types of uses, viz. electronics, dentistry and other industrial uses, amount to a relatively small portion of total consumption. Also their relative shares do not change substantially during those years before us. Roughly speaking, 13 to 16 percent may be counted for these uses against total consumption. Of interest is that the gold consumption in medals and medallions is small yet still significant enough to make up between 2 and 3.2 percent for those years. Therefore, the industrial use for gold is stable as regards the four last components. However, greater instability must be recognized in jewelry.

Financial Holdings

As shown in Table 1, the use of gold for financial purposes ranged between 35.8 percent and 18.2 percent. It decreased to this level of distribution when the jewelry demand for gold shot up by more than 29 percent between the years 1975 and 1976. By the year 1978 it had settled at 25.8 percent. Among the financial uses of gold, two categories are noticeable: official coins and private holdings for hoarding, speculative and investment purposes. Initially, the importance of official coinage was larger but in more recent years, private acquisition of gold has become more important which may reflect the uneasiness expressed by the public regarding the world financial conditions and the

uncertainty of the future of the world monetary system. In essence, the use of gold for financial purposes is marked by the variability in its components.

Industrial Consumption of the U.S.A. (1964-1978)

In view of the fact that the U.S.A. is the mainstay of the free industrial world and its greatest producer and the wealthiest country of the world - to use the most common picture for a descriptive background - it is surprising to note that the U.S.A. consumed less gold in 1978 than in 1964. This is brought out in Table 2 which shows a rise in industrial gold absorption from 1964 until 1972 with some intermittent downward adjustments. After this year the industrial consumption for gold literally collapsed to below the 4 million troy ounces level in 1975. From then onward, it slowly recovered. At this time, it had become legally possible for the average U.S. citizen to hold gold again. Even then, no substantial increase in demand for gold for investment and financial reasons took place. The gold use for investment purposes, in percentage terms, is much smaller than in the rest of the world but it is displaying a similar variability.

Comparing both tables, Table 1 and Table 2, the consumption of industrial gold in the United States amounted to 11.1 percent of the world total industrial gold consumption in 1975. Gradually it decreased to below 9 percent (8.9) in 1978. In general terms,

TABLE 2

Industrial Demand for Gold in the U.S.A. and its Percentage
Distribution by Type of Consumption for the Years 1964-1978

Year	Total Industrial Demand ('000 of Troy ounces)	Jewelry and Arts %	Dental use %	Electronic Industrial %	Investment %
1964	4900	53.1	10.6	36.3	0.0
1965	6010	62.9	10.1	27.0	0.0
1966	7240	60.8	9.0	30.2	0.0
1967	7410	61.0	9.1	29.9	0.0
1968	6927	59.2	11.7	29.1	0.0
1969	7408	54.0	9.7	36.3	0.0
1970	6891	55.9	11.0	33.1	0.0
1971	6684	62.0	10.8	27.2	0.0
1972	7638	59.6	10.3	30.1	0.0
1973	6904	51.6	10.1	38.3	0.0
1974	4651	51.7	10.9	37.4	
1975	3992	52.1	14.9	26.5	6.5
1976	4648	55.1	14.9	26.6	3.4
1977	4859	54.7	15.0	24.8	5.5
1978	4800	55.6	15.5	27.5	1.4

Source: American Metal Market, Metal Statistics, Fairchild publ. N.Y.

U.S.A. import sources 1975-78: 43% Canada, U.S.S.R. 20%, Switzerland (South African Gold)
17%, 20 from other countries.

gold use in jewelry in the United States is not quite 55 percent whereas it is 80 percent for the world as a whole. In the dental field, world usage, on the average for these years, is 7 percent while the citizens in the United States utilized 15 percent of all industrial gold in dentistry.⁸ In the electronics area, it is not surprising that the United States put 26.4 percent of its gold used into that particular industrial branch, whereas the world as a whole accounted for only 12.5 percent of this usage.⁹

However, it is also true that the relative importance of gold in the electronics field has been somewhat on the decline between the years 1964 and 1978 as the percentage distribution indicates with the year 1964 showing 36.3 percent and 1978 only 27.5 percent. The presence of several substitutes may account for this behaviour.¹⁰ In the overall picture of industrial gold consumption of the United States, there is a great stability in the use of gold for jewelry. In the dental field, the preference for gold has steadily increased from about 10 percent to 15 percent. The consumption of gold for investment purposes does portray a smaller significance than in the rest of the world, although the irregularity is highly similar.

World Gold Holdings

If one accepts the view of an outstanding Canadian gold mining economist, Dr. Paul Kavanough, then the world has produced

during the 6,000 years prior to the Canadian Centennial Year a total of 3 billion ounces of gold, 2 billion of which were recovered since the time of Columbus. Of this total, 750 million, or 25% of the output of 3,000 million ounces came from the mines of South Africa;¹¹ Canada's contribution to this total is approximately 183.7 million ounces or about 6.1 percent.¹² To obtain a total for 1979, one would have to add more than 460 million ounces produced since 1967, at least in the Free World. If one is to include the output of the U.S.S.R. - which cannot be estimated - at over 80 million ounces - or an annual average of over 200 metric tons - then one would quite easily see a total world gold stock of over 3.5 billion ounces. Of this total, 1873.1 million ounces were accounted for in the year 1978. This is brought out in Table 3, which provides the corresponding percentage distribution.

This quantity is equivalent to the output of about 53 years given the annual Free World production of 33,505,000 ounces over the last thirty years. Yet, a very interesting question remains: where is the other half of the gold which has seen the light of day? Suffice it to say that the tabulation provides an account only for known or estimated official and private holdings, including even those of the U.S.S.R. and of China. However, we have to consider that the holdings of

cultural and religious institutions are not taken into account. In those organizations, gold takes the form of a public utility as gold is enjoyed in its beauty by a large number of people! In houses of worship, the splendour of precious stones and metals does not fail to impress the beholder. Other analysts may see these holdings perhaps in a different light, as for instance, Martin Larson and Stanley Lowell, in their book, Praise the Lord for Tax Exemptions,¹³ have it - and this, of course, is taken from another author - that in 1968, the gold holdings of the Vatican amounted to 10 billion dollars. At a price of \$35. which applied at the time of publication of the book would have meant 285 million ounces accounting for not quite 17 percent of the deficiency. Any attempt to assess the distribution of the holdings by cultural and religious institutions will, forever, remain conjectural.

Other treasures have disappeared from the general view. One could think here of the legendary Hoard of the Nibelungen which disappeared in the Rhine when Attila, the Hun, roamed over Europe. Other more concrete examples would include the sunken and unrecovered treasures of the Spaniards and Portuguese as well as those treasures lost by all seafaring nations. One should not forget the 'contributions' to the unaccountable made by the Treasure of the German Reichsbank which disappeared under highly mysterious circumstances at the end of the Second World War.¹⁴

The assessable world gold stock is held to 54.0 percent by Central Banks to which has to be added the 7.3 percent in the International Monetary Fund and the International Bank of Settlements in Basel. In total, over 60 percent are held by financial authorities.

TABLE 3

World Gold Stock and
Distribution for the Year 1978
(in millions of Troy Ounces)

	<u>Quantity</u>	<u>%</u>
<u>Central Bank Reserves</u>		
U.S.A.	277.3	14.8
Germany	118.4	6.3
France	101.8	5.4
Switzerland	83.4	4.5
Italy	82.9	4.4
Other	<u>349.0</u>	<u>18.6</u>
Subtotal	1012.8	54.0
<u>International Organizations</u>		
IMF	127.2	6.8
BIS	<u>10.1</u>	<u>0.5</u>
Official Gold Stock	137.3	7.3
<u>Communist Countries</u> (estimated)		
U.S.S.R.	95.0	5.1
China	<u>13.0</u>	<u>0.7</u>
Subtotal	108.0	5.8
<u>Private Holdings</u>		
France	200.0	10.7
Other European Countries	37.0	2.0
Middle East	51.0	2.7
Far East	42.0	2.2
India	120.0	6.4
U.S.A.	105.0	5.6
Other	<u>60.0</u>	<u>3.2</u>
Subtotal	615.0	32.8
<u>World Total</u>	1873.1	99.9

Source: American Metal Market, Metal Statistics, Fairchild publ.

SECTION III: GOLD MINING PRODUCTION

The purpose of the following section is to review the performance of output of mined gold of the world for the years 1950 to 1979; to review the Canadian contribution to that output and to evaluate and compare the role which the Province of Ontario played in this area. Due to the fact that statistics are available for the Free World only, at least until the year 1977, the importance of the U.S.S.R. as a world gold mining country can only be studied since 1978. The position of the U.S.S.R. is then seen when the world's most important gold producers are discussed.

World Gold Output

The performance of world mining output of gold is marked by a steady rise from 1950 until 1971 when it started to decline. In the year 1950, the output of the Free World was about 752 metric tons, as demonstrated in Table 4. It slowly climbed to 1,291 metric tons over the next twenty years and slowly fell back to a level which it held in the years 1957 and 1958. This means that by 1979 the production of gold had fallen to about 950 metric tons.

Canada

By comparison, the Canadian gold mining activities did not experience the substantial rise in output as the world did.

TABLE 4

Canada's and Ontario's
Importance in World Gold Production
for the Years 1950 - 1979

Years	Output metric tons		Canadian Share (%)	Ontario's Share (%)
	<u>World</u>	<u>Canada</u>		
1950	752	138.1	18.36	10.18
1951	735	136.6	18.58	10.42
1952	756	139.1	18.40	10.34
1953	751	126.5	16.78	9.03
1954	797	135.8	17.04	9.22
1955	836	141.3	16.90	9.39
1956	871	136.4	15.65	8.97
1957	905	137.5	15.13	8.80
1958	934	142.2	15.22	9.04
1959	1002	139.5	13.92	8.33
1960	1044	144.0	13.79	8.14
1961	1080	139.2	12.88	7.59
1962	1152	130.0	11.28	6.54
1963	1202	124.5	10.36	6.05
1964	1247	119.3	9.57	5.38
1965	1278	112.2	8.78	4.75
1966	1278	103.2	8.08	4.04
1967	1239	92.9	7.50	3.76
1968	1250	85.5	6.84	3.44
1969	1262	79.2	6.27	3.03
1970	1291	74.9	5.80	2.80
1971	1253	70.3	5.61	2.81
1972	1190	63.1	5.31	2.60
1973	1140	60.8	5.33	2.52
1974	1029	52.8	5.13	2.42
1975	987	51.4	5.21	2.38
1976	993	52.5	5.28	2.31
1977	988	52.9	5.36	2.29
1978	969	54.0	5.57	2.32
1979	954.	49.2	5.16	2.02

Source: United Nations: Statistical Yearbook, "Extractive Industries"; New York, N.Y.; and Laurentian University Research, Technical Information Paper No. 2.

Rather, her level of output stayed close to the 140 metric ton mark which it exceeded slightly only three times. viz, in 1955, 1958 and in 1960 when the high of 144 metric tons was recorded. In contrast to the world as a whole, whose output still rose for another decade, Canada's gold output started on its long decline which ended in 1979 with a total output of a mere 49 metric tons. During these years, the performance of the gold mining industry was reduced by two thirds from its former output level. This is certainly not a very encouraging picture as it describes the decline of the Canadian gold mining industry.

Canada and Ontario: World Shares of Mined Gold

How bad the performance was for Canada as well as for the Province of Ontario cannot be seen in a more dramatic way than in the respective columns of Table 4. As a Free World producer, the Canadian position of holding 18.4 percent of the total eroded to a mere 5.2 percent. However, when the eye is turned towards Ontario as a world producer, things are even more disheartening. At one time, Ontario could claim to produce 10 percent of the world output of gold. Today, it is a mere 2 percent. Ontario has become an almost insignificant producer! This means that the drop in gold mining has been worse in Ontario than for the country as a whole.¹⁵

The Main Producers of the World

Obviously, South Africa is the world's number one gold producer and will remain so for a long time. As can be seen

from Table 5, South Africa has become a gold producer of mounting importance even if the role of the Soviet Union is taken into consideration. If South Africa produced 48 percent of the world known gold output in the year 1950, which evidently excludes the production by the Soviet Union, its share of 58 percent for 1979 reflects its sole, dominating position. However, there is likewise no doubt about the fact that the U.S.S.R. is the world's second largest producer of gold, a position once occupied by Canada. With over 20 percent, the U.S.S.R. has an unusual market power through which it could, if it wanted to, change the financial climate of the world at any time. Of course, it is futile to speculate on what the plans of the U.S.S.R. are in this respect.

The fate of the gold mining industry experienced in Canada struck the United States in equal measure. While the Canadian world share of 18.4 percent was reduced to a mere 5.2 percent (or 4.1 percent when the U.S.S.R. is taken into account), the position of the United States declined at a similar rate, from a high 9.5 percent to 2.9 percent (or 2.3 respectively including the U.S.S.R.). Both Canada and the U.S.A. lost more than two thirds of their relative positions as the largest gold producers in the world behind South Africa and the U.S.S.R.

When considering the remaining producers in the world - of an approximate total of fifty-five,¹⁶ five countries are small but still significant producers, as each delivers about 1½ percent of total world output.

TAB: 5

Percentage Distribution of
World Gold Mining Production by
Country for Selected Years
between 1960 and 1979
(percentages)

Country	1950	1955	1960	1965	1970	1975	1979
Australia	3.7	3.9	3.2	2.1	1.5	1.7	(a) 1.9 (b) 1.5 3)
Brazil	0.5	0.4	0.4	0.4	0.5	0.5	0.6 0.5
Canada	18.4	16.9	13.8	8.8	5.8	5.2	5.2 3) 4.1
Colombia	1.6	1.4	1.3	0.8	0.5	1.0	1.0 0.7
Dominican Rep.	-	-	-	-	-	0.6	1.1 0.9
Ghana	2.9 1)	2.6	2.6	1.8	1.7	1.7	1.6 1.5 4)
Japan	0.6	1.1	1.0	1.3	1.7	3.3	0.4 0.3 4)
Mexico	1.7 1)	1.4	0.9	0.5	0.5	0.5	0.6 0.5
Papua New Guinea	0.3 1)	0.3	-	0.1	0.0	1.9	2.3 1.8
Philippines	1.4	1.6	1.2	1.1	1.5	1.6	1.8 1.4
South Africa	48.0	54.3	63.7	74.1	77.6	72.3	73.7 4) 58.2
Southern Rhodesia	2.1	2.0	1.7	1.3	1.2	1.9	2.0 1.5
United States	9.5	7.0	5.0	4.1	4.4	3.3	2.9 1) 2.3
Yugoslavia	0.2	0.2	0.2	0.3	0.2	0.5	0.5 0.4
Zaire 2)	1.4	1.4	-	0.2	0.4	0.3	0.2 0.2
U.S.S.R.	-	-	-	-	-	-	- 21.0

Total for these countries: 92.3 94.5 95.0 96.9 97.5 96.3 95.8 96.8

Source: United Nations, Statistical Yearbooks, New York, N.Y.

1) approximate

2) until 1955: Belgian Congo

3) a) excluding the U.S.S.R. sofar from 1950-1979;

b) including the U.S.S.R. for 1979

4) a discrepancy exists between later and earlier years which stems from two different statistical sources: ABMS, Non-ferrous metal data, 1979, which does not seem to take account of imported ores and concentrates refined in Japan.

These countries are:

Australia	Papua New Guinea	Zimbabwe
Ghana	Phillipines	(formerly Southern Rhodesia)

Of these, Australia, Zimbabwe and Ghana were much stronger producers in the 1950s than they were in the 1970s. The position of the Phillipines hardly changed at all while Papua New Guinea has been successful in making inroads into becoming an increasingly significant supplier of gold.

Other countries which once were important gold suppliers have now taken up a subordinate position. They are: Colombia, Mexico and Zaire, the former Belgian colony of the Congo.

The main reason for their decline may lie in the general nature of the depletion of existing ore bodies. As gold is being taken out of the ground, the quantity of recoverable-grade ore tends to decline. This is the general, common truth in mining but it is especially true when the size of the gold mining country is small. The probability to discover additional ores is functionally related to the size of a country. That is why some countries will be highly successful in opening up new gold mines once the price has adjusted properly in relation to the relative price system in the world. Another reason for the decline in gold output may be political instability of a particular country.

Foreign Trade: Canada¹⁷

In the area of international trade, Canada is known to export and import three types of gold products: gold ores and concentrates, gold metal and gold alloys. As to gold ores and concentrates, it can be seen from Table 6 that Canada is a net exporter of gold ores and concentrates, at least for the three most recent years under investigation. In 1977, Canada was a net exporter of 2.3 metric tons of gold in ores and concentrates which added over 7.5 million \$ (Can.) to the Canadian balance of trade (and payments). In 1978, the quantity was almost 8 metric tons with a value of \$(Can.) 34 million, while in 1979, the net quantity exported was 5.6 metric tons with a value of almost \$(Can.) 41 million.

Gold metal exports amounted to 24.3 metric tons in the year 1977, 16.4 metric tons in 1978 and 6.4 metric tons in 1979. The returns were \$(Can.) 113 million, \$(Can.) 124 million and \$(Can.) 23.8 million respectively.¹⁸ In essence, Canada exported larger amounts but her gold metal imports increased by more than her exports. That is why it appears that Canada's gold metal exports did not perform as well in 1979 as in the previous years.

When exports and imports of gold alloys are included in this structural analysis, it would appear that Canada was a net importer of alloys as regards quantities, but that for the two years 1978 and 1977, the balance in Canadian dollar terms was

TABLE 6

Canadian Exports and Imports of Gold ores,
Concentrates, Metal and Alloys; Quantities
and Values of Shipments, for the years
1977-1979

Gold Ores and Concentrates ¹⁾ (commodity 256-10)						
<u>Year</u>	<u>Quantity</u> (kg)			<u>Value</u> \$'000		
	Exports	Imports	Balance	Exports (1)	Imports (2)	Balance (1) - (2)
1979	6421	774	5647	49137	8244	40893
1978	8316	347	7969	36788	2777	34011
1977	4084	1740	2344	14992	7427	7565
Gold Metal ²⁾ (commodity 455-61)						
1979	49632	43228	6404	554195	530412	23783
1978	47423	31015	16408	337551	213234	124312
1977	30005	5732	24273	145256	32011	113245
Gold Alloys ³⁾ (commodity 455-68)						
1979	6261	48902		44341	531317	(-)486976
1978	3022	10259		13868	8288	5580
1977	5144	6178		14698	8316	6382

Source: Statistics Canada. Exports by Commodities, Cat. 65-004, Ottawa. Imports of Commodities, Cat. 65-007, Ottawa.

- 1) Commodity item 256-10 implies: Gold in ores and concentrates/Gold content only; reference source: Revenue Canada, Customs and Excise Statistics Canada, Canadian International Trade Classification, cat. CAI BS 65 C502 (1978); reference manual in effect: January 1, 1978, p. 64.
- 2) Commodity item 455-61 implies: Gold 99.95% purity and over, gold content; ibid. p. 168.
- 3) Commodity item 455-68: Gold alloys, under 99.95% purity, gold content; ibid.

positive. This picture changed completely for the year 1979, when Canada imported a large quantity of gold alloys, leaving a negative trade balance on gold alloys of \$(Can.) 487 million. Obviously, it is difficult to strike a balance between quantities of gold alloys exported and imported due to a certain lack of homogeneity among these alloys. Nonetheless, it is striking that in the field of gold exports and imports, Canada ended up with a deficit of \$(Can.) 422.3 million in terms of the balance of trade (and payments). This speaks for a very strong consumption for gold alloys which were chiefly imported from the United States of America.

Another point of concern enters this picture. Surprisingly, this has to do with the customer countries to whom Canada sent her gold ore and concentrates in the year 1978. Of the 8.316 metric tons of ores and concentrates (metal content) sold, 46 percent went to Japan as the most important customer country at a price of \$(Can.) 145.5/oz. The second most important customer for Canada's gold ores and concentrates, however, was the U.S.S.R., which took 22.2 percent of these exports or 1.854 metric tons of gold content, and this at a price of \$(Can.) 60.4/oz. As a matter of fact, this is the lowest value of sale per ounce charged in 1978 to Canadian customers, as pointed out in Table 7. Naturally, this point raises many questions which cannot be answered by this investigation due to the limited information provided by Statistics Canada.¹⁹ However, it will be shown in discussions of other metals that gold ores and concentrates were not the only cases where ores and concentrates were exported to the Soviet Union!

TABLE 7

Unit Value and Percentage Distribution of
Canadian Exports of Gold Ores and
Concentrates by Purchasing Country
for the Year 1978 (Metal content)

Purchasing Country	\$/oz	Percent of Quantity Exported
United Kingdom	196.2	7.2
Belgium-Luxembourg	184.4	1.4
Finland	83.2	0.7
France	72.5	0.5
Germany-W.	114.2	2.4
Italy	82.2	0.2
Spain	119.1	3.4
Switzerland	146.7	1.2
U.S.S.R. ¹⁾	60.4	22.2
Yugoslavia	237.6	4.5
Japan	145.5	46.0
South Korea	99.0	0.2
Brazil	187.8	2.3
U.S.A.	177.5	7.8

Source: commodity Table 3, Trade of Canada, Exports by Commodities,
Statistics Canada, cat. CAl BS 65-C004, December 1978,
p. 82.

- 1) \$3,603,000; 59,608 tr. oz. which is 1.854 metric ton
out of a total of \$36,788,000 and 267,354 tr.oz.

SECTION IV: RESOURCES AND ALTERNATIVE SUPPLIERS

At first, this section discusses briefly an assessment of world gold resources of the year 1974 and then explores general circumstances and conditions of gold production in the major gold producing countries. They are, with the exception of Canada: South Africa, U.S.S.R., U.S.A., Brazil, Peru, Phillipines, Australia and China. Conditions and prospects of less significant producing countries will be investigated subsequently. They are: India, Bolivia, Ivory Coast, and Algeria.

World Gold Resources

J.M. West, physical scientist of the United States Bureau of Mines, provided an estimate of the gold resources of the world in Mineral Facts and Problems, 1975. According to these estimates, total gold resources when seen beyond the then prevailing prices of gold of \$150 to \$200 per ounce amounted to 59,097 metric tons.²¹ The main resource holder was South Africa with 52.63 percent, followed by the U.S.S.R. with 15.79 percent and the U.S.A. with 12.63 percent. Canada ranks fourth with 3.42 percent on this list of the major gold-resource holding countries. Therefore, these four large countries accounted for 84.47 percent of known deposits while the remainder is split unevenly among twelve countries or geographic entities. The total distribution is set out in Table 8.

TABLE 8

Distribution of Total Gold Resources of the World
of 59,097 Metric Tons by Country (Metal Content)
and Geographic Area for the Early 1970s

Country	Percentage
Canada	3.42
Mexico	1.21
United States	12.63
Other America	1.16
South America	1.63 1!)
U.S.S.R.	15.79
Other Europe	1.10
Ghana	1.58
Zimbabwe	1.32
South Africa	52.63
Other Africa	1.58
Japan	0.53
Phillipines	1.32
Other Asia	1.32
Australia	1.84
Other	0.94
World total	100.00

Source: J.M. West, loc. cit. See esp. n. 4,13 and 14, ibid., p. 453.

1!) N.B.: The figure given for South America is definitely a very serious understatement. The difference comes about because Brazil is known to have a potential ore reserve ranging between 16,425 tons and 50,000 tons although "some sources have expressed doubts about Brazil's capacity to increase gold production - at least in the short term." See Francisco Alves, "Brazil", Mining Annual Review, 1980, London, p. 402. Given a total world reserve of 59,097 metric tons and assigning to Brazil the total of 1.63% or 963 metric tons on Table 8, the world reserve would then range between 74,559 and 108,134 metric tons through this adjustment alone.

It is, of course, quite evident that since the early 1970s, adjustments as to size and distribution of gold resources have taken place and that other estimates could be drawn upon. To some degree, this investigation will, at the end of this section, make allowances for how this distribution may have changed in the meantime. Suffice it to say, that according to the estimate of the U.S. Bureau of Mines, at least 1.9 billion ounces of gold are recoverable from this earth. This implies that altogether the total gold potential in possession of nature and men would amount to at least 5.4 billion ounces or 168,000 metric tons. The discovery of "lucky strike" bonanza deposits in well populated areas, the assessment resulting from new discoveries in normally inaccessible geographic areas and the transformation of mineral deposits into recoverable ores due to the upward adjustment in the price of gold will necessarily add to the general earthen gold lode beyond the 5.4 billion ounces figure.

Alternative Suppliers

South Africa

If one is to accept the estimated gold reserve for South Africa of 1.0 billion ounces or 31,104 metric tons as a reliable figure - this stands somewhat in contrast to other figures revealed by South African gold experts - then, present efforts

of gold mining in South Africa are concentrated on a known, delineated ore body which is just 7 percent of that overall potential. Nonetheless, this particular ore body containing 72.4 million troy ounces in gold (or 2251.9 metric tons) contained in a total rock tonnage of 155.8 million metric tons. This represents one of the largest exploitable bodies of gold ore on earth. The quality of this ore is 0.465 troy ounces per ton.

In the year 1979, South Africa produced 702.84 metric tons of gold. In 1978, it was 704.46 metric tons and 699.89 metric tons in the year 1977. Evidently, this is not a strong increase in output after the general rise in the price of gold during those years, especially for the year 1979, when the output actually decreased over the previous year!

However, the increase in the price of gold, as it finally materialized, is expected to lead to an increased output of gold over the next ten years. This is particularly true since South Africa distinguishes between rich and poor gold mines. One has to bear in mind that the operating cost in 1978 for producing one ounce of gold was set at \$ U.S. 130.- which was up from \$ U.S. 113.- for the years 1976 and 1977 and that this general trend is bound to continue. This means that the number of profitable mines will be increasing if the price is rising faster than the cost of production of an ounce of gold.

Table 9 offers an insight into the price-cost relationships of South African mines for the year 1978.²² At that time, the

TABLE 9

Operating Costs of South African

Gold Mines in \$U.S./oz gold

as of September 1978.¹⁾

East Driefontein	45.74
West Driefontein	49.68
Randfontein	64.24
Free State Geduld	74.47
Winkelhaak	74.75
Western Holdings	76.90
Western Deep Levels	79.51
Kloof	84.81
St. Helena	87.42
Kinross	90.53
Bracken	94.21
President Brand	94.28
Marievale	102.90
Blyvooruitzicht	104.55
Hartebeestfontein	109.27
Libanon	109.38
Vaal Reefs	114.60
President Steyn	119.75
Barberton	127.80
Doornfontein	128.66
Buffelsfontein	128.77
Grootvlei	130.02
Welkom	141.68
Leslie	144.76
Western Areas	152.98
Stilfontein	158.71
Durban Deep	187.29
Venterspost	194.05
Lorraine	212.58
E.R.P.M.	217.33
Wit. Nigel	227.56
Free State Saaiploas	232.64
West Rand (u)	386.85

Source: International Minerals/Metals Review 1980, ibid. p.64.

¹⁾ South African gold ore reserve statistics are revised quarterly each member mine of the Chamber of Mines of South Africa and made available to the public as part of that organization's publication, "Analysis of Working Results" (of the gold/uranium mining members of the Chamber).

cut-off line - the line separating the rich from the poor mines - was at \$ U.S. 130.-. This means that all mines with a production cost of below that figure were highly profitable, while those above were obviously in a less fortunate position. However, in the light of the advancement of gold price over the years 1979 and 1980, there is no doubt that now all of these mines are highly profitable.

It is Table 10 which illustrates the conditions of profitability by stating tonnage and, above all, the type of grade minable in the various occurrences. This information may be particularly interesting for those who want to compare the grades faced by the South African mining companies to those in other countries, especially in Canada and in Ontario.

The impact of the rise in gold prices cannot be denied to have world-wide repercussions in the gold mining field. This means that, in the long run, output will rise as ore bodies - by definition - have been enlarged, expanding the lives of existing mines and reviving those that, due to low ore quality, had been forced to terminate operations.

It was noted that in 1979, the output of South African gold mines declined in spite of the large price hike of the metal. The reason for the decline is that South Africa can now mine lower-grade ores, that is in the short run. In the long run, however, it is recognized that the increase in ore potential of existing and marginal mines will lead to an expansion of existing and the opening of new mines.²³

TABLE 10
Proven Gold Ore Reserves of
South African Mines
Ore Quantity and Grade
As on September 30, 1978

<u>Gold Producers</u>	<u>Quantity '000 mt.</u>	<u>Grade troy ounces mt.</u>
Blyvooruitzicht	5,109	0.730
Bracken	1,000	0.309
Buffelsfontein	6,748	0.402
Doornfontein	1,975	0.421
Durban Deep	871	0.264
East Driefontein:		
Ventersdorp C.R.	4,599	0.919
Main Reef	100	0.305
E.R.P.M.	1,374	0.402
Free State Geduld	7,320	0.611
Free State Saaiplass	1,184	0.234
Grootvlei:		
Kimberley Reef	800	0.183
Main Reef	40	0.190
Harmony	17,777	0.251
Hartebeestfontein	11,444	0.428
Kinross	4,300	0.302
Kloof	3,504	0.559
Leslie	800	0.241
Libanon	1,793	0.666
Lorraine	2,338	0.424
Marievale:		
Main Reef	100	0.244
Kimberley Reef	100	0.231
President Brand	7,971	0.480
President Steyn	10,031	0.415
Randfontein:		
Cooke No. 1 Shaft	1,646	0.472
Cooke No. 2 Shaft	1,027	0.293
Randfontein - S.D. 32 Shaft	361	0.084
St. Helena - Basal Reef	5,300	0.594
S.A. Lands	N.A.	N.A.
Stilfontein	3,222	0.434
Vaal Reefs:		
Vaal Reef	15,149	0.498
V.C.R. and Elsburg	114	0.364
Venterspost	1,499	0.324
Vakfontein	Closed	November 1977
Welkom	4,462	0.378
West Driefontein	5,249	0.893
Western Areas	7,546	0.277

...cont'd.

TABLE 10
(continued)

<u>Gold Producers</u>	<u>Quantity '000 mt.</u>	<u>Grade troy ounces mt.</u>
Western Deep Levels:		
Carbon Leader	2,629	0.820
Ventersdorp C.R.	1,890	0.498
Western Holdgins	7,921	0.571
Western Rand Cons:		
Gold Section	135	0.303
Uranium Section	390	0.045
Winklehaak	5,700	0.350
Wit. Nigel	<u>232</u>	<u>0.272</u>
	155,750	0.465

Source: the same as Table 9 , p. 65.

(Source of Data: "Analysis of Working Results," Chamber of Mines
of Mines of South Africa, July-September 1978.)

Mr. Dennis Etheridge, President of the South African Chamber of Mines, has pointed out that South Africa is facing staggering costs of production in all its gold mining efforts,²⁴ which will be accelerated by the inflationary pressure in the South African economy brought about by the new gold boom.

The question remains as to the secular prospects of gold mining in South Africa when the view is turned to the next century. Admittedly, the production costs are rising, but there seems to be some type of a consensus expressed by Mr. Etheridge - and this is taken from an article by Terry Mendenhall - that South Africa will produce 15,000 metric tons if not 20,000 metric tons of gold over the next fifty years.²⁵ This means an approximate output of 700 metric tons per year, which is the same as the 1979 production level. This level is to be maintained until 1987 when it will start to decline to an overall average of 300 to 400 metric tons per year for the remainder of this secular time span. It also means that the expected rise in output will only be temporary, if it is significant at all.

U.S.S.R.

It has been customary for many economists and politicians to delegate a special role to the U.S.S.R. in the sense that it cannot be conveniently included in the analysis of the Western World since the U.S.S.R. belongs to the group of nations labelled as "centrally planned economies." They have their own market structure and performance incompatible with ours. In this sense,

the U.S.S.R. is unrelated to the Western economies and cannot be included as being of a different kind. The U.S.S.R. is tugged away in an assumption that it does not play any role in the eyes of the analytical beholder of this myopic variety.

It is the opinion of these economic researchers that it is a grave error to exclude the Soviet Union from this analysis except for the unavailability of data. The centrally-planned economies have their own market which is, to a large degree, directed in a monopolistic fashion by the U.S.S.R. which dominates that part of the real world. However, this does not mean that it is excluded from the Western market to which it has access and has had it all the time. Here, it plays the role, in good old mercantilist fashion, of an oligopolistic competitor looking after its own good. In this fashion, the U.S.S.R. is able to exploit both market structures to the best of its interests, especially through trade in minerals.

In recent years, the U.S.S.R. increased its exports of minerals, especially in 1978, with fuel exports demonstrating the fastest rise. Fuels, minerals and metals amounted to 48% of total official exports during that year. In spite of rising domestic demand, the U.S.S.R. will augment mineral exports although most of the exported commodities could be easily absorbed domestically.²⁶

It is well known that data on Soviet gold production have been scarce ever since the 1930s, but there is little doubt that

the U.S.S.R. is the second largest gold producer in the world. Different sources give different estimates. For the year 1978, the following values were obtained from three different sources:

- a) Mr. Beckett of Gold Fields Ltd., using satellite photography of Soviet production areas, combined with new information about mining technology, estimates that gold production in the U.S.S.R. is somewhere between 280 and 350 metric tons per annum and not any longer 450 metric tons as previously assumed.²⁷
- b) The publication of the American Bureau of Metal Statistics²⁸ lists the output for that country for the year 1978, as 273 metric tons, while
- c) The International Minerals/Metals Review put it at 250 metric tons.

Naturally, there is a difficulty in making a decision as to which figure to adopt. For reasons of consistency in the overall use of data for this research project, the choice has fallen on the figure of 270 metric tons. This value may reflect a less enthusiastic outlook concerning the gold output potential and is therefore a more conservative view of the future output possibilities of the U.S.S.R. than others may be inclined to accept.

Two thirds of the gold comes from the Soviet Far East, Yakutia and East Siberia; most of the remainder is mined from gold, copper, and lead-zinc ores in the Ural Mountains, Kazakhstan, Armenia and Uzbekistan. Not surprisingly, the U.S.S.R.

is most conscious of the foreign exchange value of gold sales, particularly at the prices quoted for the years 1979/1980.

It is interesting to see that already in 1978, the U.S.S.R. sold 350 metric tons in the world market, which is 100 metric tons above its estimated annual output.

The potential reserves are 6,200 metric tons according to one publication²⁹ and 9,331 metric tons according to the other as referred to above in the assessment of world gold resources.³⁰ In light of the lower estimate, Soviet sources maintain that these reserves are sufficient for 12 to 15 years. This would mean an upward adjustment of the assumed output figure of about 270 metric tons per annum, because over a time horizon of 12 to 15 years, the output rate would be at 400 metric tons per annum and above. When seen in the context of the figure stated by the U.S. Bureau of Mines and accepting an annual recovery rate of 270 metric tons, the assessed ore resources of the U.S.S.R. would last for another 34 years.

Both figures may be understatements because it is known that in view of the hard currency importance of gold to the Soviet economy, very intensive and systematic prospecting is taking place in the Asian part of the country. This search will not fail to produce significant results. The observation has also been made that where big mines in the main gold producing areas are experiencing lack of reserves, plants and equipment have been moved to more distant locations.

To illustrate the magnitude of gold operations in the U.S.S.R., a glance should be taken at the main producing centre, Magadan Oblast. It contains about 35 placer mines with 23 dredges, more than 500 sand-washing rigs and uses 1,500 bulldozers. Another Magadan Oblast enterprise is the Kararuken mining and concentration complex which is the first of its kind to produce both gold and silver.

On the distribution side, the U.S.S.R. has taken a new approach. Recently, for the Olympic Games, the U.S.S.R. issued 130,000 gold coins with a denomination of 100 roubles for world-wide sales. Also, for the first time since 1924, the U.S.S.R. has become engaged in the issue of 450,000 sets of six silver coins per set in five consecutive series. Also, a 150 roubles platinum coin was added to crown the entire Olympic commemorative issue. No question, a very overt expression of international market operation directed at the foreign retail level.³¹

U.S.A.

The gold mining industry in the United States counts about 175 mines within its boundaries, most of which are located in the Western part of the country. Of these mines, over one third produce gold as their chief output. The concentration is such that in the year 1979, three mines produced 65 percent of that output while 25 mines altogether mined 95 percent of the total.

The share of gold mines from native deposits is approximately 60 percent, while the remaining 40 percent originate from by-products of base metal operations, mainly from copper ores.

In the year 1979, the output of the United States amounted to 27.6 metric tons. This is not a very large quantity, considering that the reserves of the United States are about four times that of Canada which produced 49.2 metric tons during the same year. However, indications are that there will be a substantial increase in output in the United States in the years to come. On the base of preliminary figures, it would appear that by 1983, the mining output of gold will increase by at least 25 metric tons at a planned investment outlay of \$168.4 million. This still would fall short of what could perhaps be produced in the United States, given their ore resources in comparison to the Canadian rate of production. On the base of a resource comparison, there should be a U.S. potential to produce annually to about 200 metric tons, everything being equal.

If one accepts the ore potential of the United States to be around the 7,465 metric ton mark, then the lifespan of this reserve at the rates of 50 and 200 metric tons per year would be 149 and 37 years respectively. It is, of course, difficult to assign production rates to the United States from this point of observation. However, an output capacity of the United States of 100 metric tons per year should not be considered an impossibility. On the basis of a rough figure, the life expectancy of gold resources would be about 75 years.

With the rise of the price of gold, exploration activities - especially in the Western States - intensified.³³ Several new

but small mines entered the production phase. However, it is of extreme significance to note the general short run phenomenon that in the United States, too, the output declined in 1979 over 1978 by 9 percent "as producers took advantage of the higher gold prices to mine leaner ores."³⁴

One additional point should be made, and that is the possible effects of technology change and advancement in the recovery of gold ores. The U.S. Bureau of Mines is heavily engaged in investigating and supporting research in technologically more advanced methods for the recovery of precious metals including gold from ores as well as scrap. The Department supports feasibility studies on promising ore samples. But on a wider scale, it is recognized that technology is improving in all fields of the recovery of gold: exploration, development, mining, milling and processing; the entire gold mining industry may benefit as it is anxious, and not only in the United States, to increase the economic efficiency on all fronts of gold mining.³⁵

Brazil

Brazil has been a relatively unimportant producer as its gold output fluctuated between 4 and 7 metric tons, according to the statistics of the United Nations. The larger volume was registered in the year 1973. Recent developments, however, seem to change this picture fundamentally. One report has it that Brazil's gold output in 1978 was actually 15.3 tons as new deposits had been discovered.³⁶

The Brazilian gold production as seen by Gold Fields for 1979 amounted to 26.1 metric tons, which was expected to climb to 40 to 50 metric tons for the year 1980.³⁷ This huge increase in gold output is the result of extraordinary deposits recently discovered. Given the size of that country,³⁸ and considering that Brazil still counts to the middle income countries,³⁹ it can only be viewed as being at the threshold of modern industrialization. Extensive and systematic exploration activities in the world's greatest storehouse of unexplored minerals will unquestionably unearth substantial quantities of gold. Understandably, these reserves have not yet found their way into resource assessments! If one takes into account the geological-geographic affinity of the gold-bearing areas of Africa to the land of South America, and especially to Brazil for that matter, there is more than a reasonable chance that Brazil will sooner or later become one of the leading gold producers of the world.

This argument gains in strength if one reads of one of these discoveries in Brazil: Serra Pelada. In this case, a farmer discovered gold nuggets on his land. As the word of this find spread, gold fever struck, leading to a gold rush of such proportions that the Brazilian government had to step in and bring it - and with it the gold - under its control. Time, at the end of its report, goes as far as stating that

"if illegal gold exports could be stopped and all the country's gold deposits controlled in the same way as Serra Pelada Brazil could count on an annual yield of 300 tons of the metal. That is 40% of the production in South Africa..."⁴⁰

Given the size of the country and the untapped mineral wealth of this tropical giant, it is only a matter of time until Brazil will be at least the third largest gold producer in the world. The later this take-off takes place, the longer will it be extended into the Twenty-first Century. In short, Brazil has to be reckoned with as one of the most important suppliers of the future.

Peru

As Brazil's neighbour, Peru has always been a gold producer though of medium size. In 1979, it added 3.6 metric tons to the world total. Over recent years, output has been rising slowly from different sources. Placer gravel in the rivers on the eastern side of the Andes is one of those sources. Gold washers in the jungle of Peru, likewise, deliver about 1 ton per annum to the Banco Minera. Half a ton comes from the only native lode gold mine of Minas Ocona, S.A. In the year 1977, Banco Minera - the Mining Bank - discovered a large placer deposit in the Alto Laberinto area at the Madre de Dios River in Southeastern Peru with a potential reserve of 108 metric tons.⁴¹ In addition, several interesting placer deposits are known to exist in this part of Peru.

The government of Peru has provided incentive legislation to promote gold mining in Peru, while Minero Peru is soliciting foreign and domestic firms to join in the exploitation of the

well-known San Antonio de Poto gold placer deposit, for a long time regarded as one of the most lucrative prospects for the gold industry in Peru.

One may not be too far from the truth if one argues that the extraordinary development to be expected in Brazil's gold industry will make itself felt also in Peru. Consequently, substantial increases in gold output by Peru will pave the way to establish Peru as an even more prominent gold producing country than it has been at the end of the 1970s.⁴²

Phillipines

In the Phillipines, primary gold production had been on the decline, although general production over the last three years of this study had been relatively stable around the 17 and 18 metric ton mark.

This decline had been attributed to rising operating costs, depletion of reserves and a general lack of financial resources. This situation changed dramatically with the rise in the price of gold. Considering that the break-even price for primary production had been \$200/oz. in the year 1977, gold prices around the \$600/oz. mark had provided a new lease on life of the Phillipine gold mines.⁴³

That the Phillipines were able to maintain their position as a medium to small-sized gold producer was mainly because gold is also mined as a by-product of copper. Thus, gold production in 1975 was 15.6 metric tons and 17 metric tons in the year 1979.

With a rising demand for copper and relatively strong gold prices, a rise in gold output by the Phillipines can be quite substantial. This 9 percent increase occurred at a time when primary gold mining production decreased by 6.8 percent. The drop-off of the primary sector was more than cushioned by the copper-related output of gold.

However, there is another factor which contributed to the relatively poor performance of the primary gold mining sector in the Phillipines. The noticed short-fall was also due to a mass resignation of miners of the firm Benguet Consolidated, Inc., the larger of the two biggest gold producers. The reason for this mass resignation was that the company had installed metal detectors at the mine gate to prevent "high-grading" by miners. The output of this company is expected to rise by 50 percent with the coming-on-stream of an additional mining operation at the Dizon copper-gold project.

The second largest producer is Apex, with a capacity to produce gold of 0.55 that of BCI. In the year 1978, it produced 11,746 ounces of gold (0.365 of a metric ton) and 7,020 ounces of silver (0.218 of a metric ton). This output capacity will be improved through more technologically advanced recovery processes. This means that it is more than likely that, over the near future into the mid 1980s, the gold output of the Phillipines may surpass the 25 metric ton mark through the Dizon copper-gold

operations and the capacity increases of Apex alone. This picture could become even more encouraging if one looks ahead to the \$275 million which will be invested by a number of different companies on different projects which also will raise the output potential.⁴⁴ Very rough estimates could deliver another 6 to 8 metric tons of gold per annum such that the output of the Phillipines may eventually double from that of the year 1975, which had been 15.6 metric tons.

Australia

This country is rich in mineral resources, producing more than 70 metals and minerals. Gold is one of them. For the year 1979, Australia's gold output was 18.3 metric tons with an estimated overall resource potential of 1,089 metric tons.⁴⁵ In contrast, the so-called "known" deposits are recognized to be 227.1 metric tons.⁴⁶ This would imply that at the 1979 rate of extraction, Australia would run out of the "known" reserves by the year 1992. The lifespan of Australia's gold resources would carry it ahead for another 60 years.

Given the upswing in drilling and exploration expenditures since 1975/76, as well as the application of modern technology plus large infusion of capital, Australia will not fail to enlarge its output - if not also its world production share - to that of a medium-size producing country that it once had been (1950).

Naturally, a number of years will be necessary to accomplish this feat as the effects of these mining activities are slow in producing visible results. Recent public announcements of gold nugget finds of unusual magnitude do lend additional support to the argument that Australia is approaching an important turning point on its road to regain her position as one of the world's significant gold producers. Unfortunately, it is not possible to more precisely assess the magnitude of this expected increase.⁴⁷

India

India's output of gold for the years 1975-1979 were as follows:

	metric tons
1979	2.64
1978	2.77
1977	1.99
1976	2.21
1975	1.61

Obviously, India is an unimportant producer of gold. Its main mines are the state-owned Hutti Gold Mines Co. and the Bharat Gold Mines, both in Karnataka. Since gold consumption in India amounts to 65-70 metric tons annually, the production from mines is completely insufficient to satisfy this need. Half the demand is satisfied from gold scrap, while

the remainder is either smuggled - between 25 and 40 metric tons - or sold by religious institutions. At one time, the state of affairs in the Indian gold market was so serious that the Ministry of Finance sold 3.2 metric tons of gold. This took place in June 1978, when the Central Bank of India had a gold stock of about 70 metric tons. So far, there is no indication of any additional reserves such that India's gold output will not change significantly in the foreseeable future. Here, India is one example of a country with a long history and culture and a highly populated area. It is also true that India is both one of the countries with the largest private gold holdings, and still a heavy consumer of the yellow metal. It is fair to say that this country has found most of the gold recoverable from its land. Through the ages, it has been depleted almost completely of its native gold. In contrast, frontier societies such as Brazil are, therefore, only the obvious candidates for gold discoveries until, one day many years in the future, depletion of gold ore deposits will also make themselves felt.

China

The last country to be discussed as a past, present or future gold producer is the People's Republic of China. With a large landmass and a huge population, it looms at the gold horizon with the possibility of enlarging its output significantly in the years to come. According to The American Bureau of Metal Statistics, China produced 6.22 metric tons of gold in 1979.⁴⁸

Mendenhall, in reference to the Beckett Report,⁴⁹ expects China's gold output soon to rise to between 30 and 60. This output will originate from small diverse gold mines as by-products from base metal production. If one looks towards the end of this century, China's output may well be in the 100 metric ton area, according to the study by David Potts of Gold Fields.⁵⁰

Summary

In summary of this quite general discussion, the following points of interest to the forecasting project may be extracted. In this way it may be possible to see the extent to which the results of this discussion will lend support to the econometric forecast further below.

Year 2000			South Africa will maintain its production level of 700 metric tons until the year 1987. From then on, it will decline averaging 400 metric tons for the remaining period of fifty years. By the year 2000, output could be down to 500 metric tons.
500			
270	335	400	The U.S.S.R. will produce at a rate of 270 metric tons per annum which may at best rise to 400 metric tons per annum by the year 2000. Eventually, output must decline even in the U.S.S.R.
50	75	100	The U.S.A. should be able to produce between 50 and 200 metric tons, although the last figure appears unrealistic, given the present low level of output.
			Brazil is the possible surprise and the spoiler of the analysis. When official reports state 5 metric tons and the grapevine of the new media put 300 into our eyes and ears, serious

15	150	300	analysis and forecasting breaks down. A hypothetical 150 metric ton average by the year 2000 and 15 - the actual present output - and the hearsay-value or 300 metric tons could provide the corresponding minimum and maximum outputs.
7	8.5	10	Peru is a relatively unimportant producer. However, its output may be up to 7 or perhaps even to 10 metric tons by the end of this century.
20	25	30	The Phillipines will increase gold output to well above the 30 metric ton mark in the very near future. Whether this production rate can be maintained over the next two decades is an unanswerable question and, therefore, can only enter as an assumption.
	35		Australia may be fortunate if it could double its output by the year 2000, if not before.
	2		India does not add greatly to the world output, but it is one of the greater consuming nations.
100			China will become a main producer by the end of this century.

Excluding Brazil and Canada, as a matter of judgment, the expected gold output of the world would amount to

	Minimum	Average	Maximum
	984	1053.5	1177
(+) Brazil	999	1203.5	1477

Before adding Canada to this total, the question has to be raised what happens to the remainder of the world which could be the remaining 10 percent of the total? The question may be unnecessary in that this entire discussion has not touched upon the case of diminishing productivity as the mines become exhausted at one

time. There is no way in which anything can be added or, respectively subtracted because this behaviour cannot be reasoned out. One might as well toss a coin. Therefore, the suggestion is to disregard the remainder of the world and the diminishing output rate under the assumption that the two cancel each other out. What is left is Canada: at worst, we maintain our output level of 50 metric tons; if things go well, we may return to an output of 100 metric tons; if optimism rules, Canada could produce 150 tons. Thus, the concluding argument of this summary is that world output will be at worst 1,050 metric tons; if we are more hopeful, about 1,300 metric tons; at best about 1,625 metric tons. Should the depletion of world gold reserves set in much earlier, even at rising prices, then the 1,300 metric ton figure would, perhaps, represent the best possible target for the year 2000, with corresponding downward adjustments for the lower output marks. However, it is also clear that at one time in the next century Brazil may take the present place of South Africa. The estimated reserve of 50,000 metric tons would be an addition to the total as indicated in Table 8. However, Brazil cannot be expected to open up the reserves that quickly.

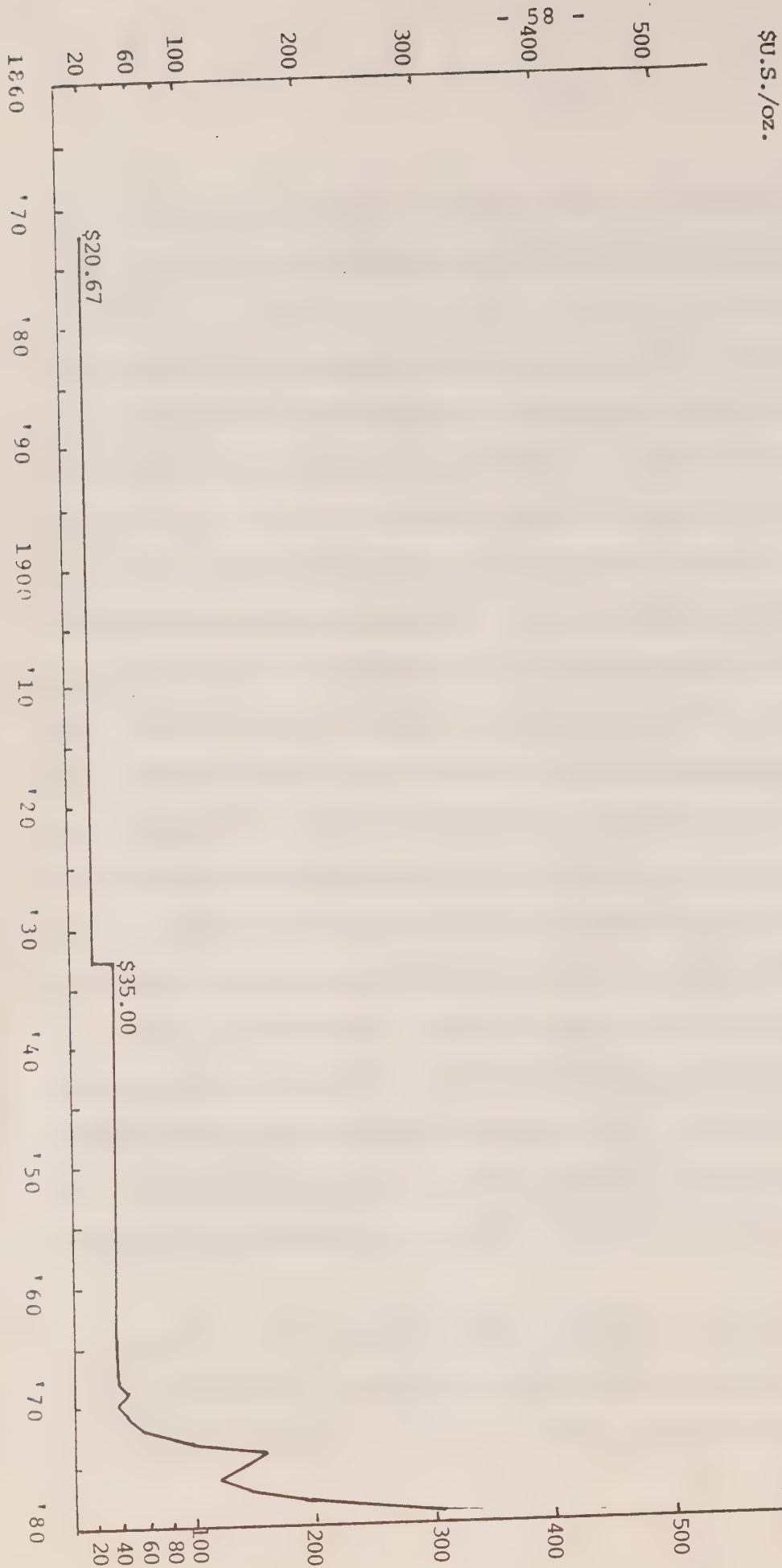
SECTION V: THE PRICE OF GOLD AND
INTERNATIONAL MONETARY CONDITIONS

The price of gold, when measured against various currencies, has been very stable over a hundred year period. This relationship is shown in Exhibit 1 as the gold price in \$ U.S. is traced out from 1872 until 1980.

At first, it was \$20.67/oz. of gold maintained under the operation of the gold standard. This standard made sure that the price of gold in terms of the various national currencies was stable, fluctuating only within a narrow range. The range was limited by the gold export and import points. If the exchange rate between two currencies was outside this limit, gold would flow in demand for the appreciated currency to be converted into the depreciated, which would deliver a quick return. This specie-flow mechanism kept exchange rates stable until the year 1914, when the gold standard was suspended. However, during the war and even after, the price of gold remained unchanged. An attempted return to the gold standard as an international system ended in failure for those countries which tried it: Great Britain and Canada are cases in point.

The international payment system between the two World Wars was characterized by competitive currency devaluation as international trade did not reflect the same spirit of cooperation

Exhibit 1
The Price of Gold
For the Years 1872-1980
in current U.S. dollars¹



- Sources: N. Potter and F.T. Christy, Trends in Natural Resource Commodities: Statistics of Prices, Output, Consumption, Foreign Trade and Employment in the United States 1870-1957, Resources for the Future, Baltimore, 1962. See also Exhibit 2;
- 1) From the European, especially the British point of view, the price of gold has been £/oz.4.25 from 1718-1918, and £/oz/4.05 from 1700-1717. See Christopher J. Schmitz, World Non-ferrous Metal Production and Prices 1700-1976; Frank Cass, London, 1978, p. 273.

which had formerly been one of the commendable qualities of the gold standard.

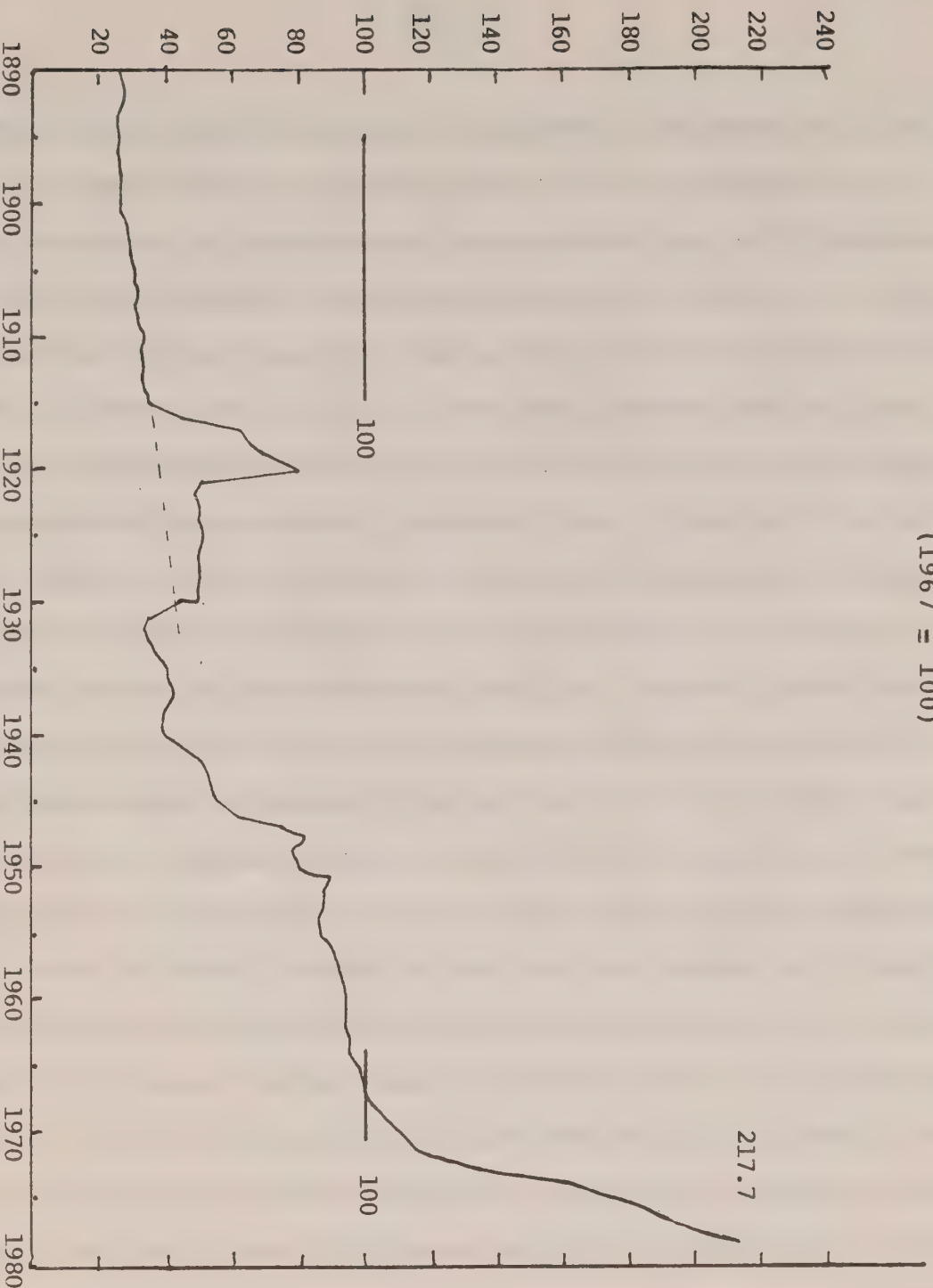
With the collapse of the credit system in the year 1929 - The Vienna Credit Institute went bankrupt - and the subsequent depression in the U.S. and the rest of the world, a general outcry for the adjustment in the price of gold was heard. The reason was that, previously, the price of gold had not kept up with the general change in prices and it was argued that such an increase would add necessary purchasing power and demand into the hands of the public. This, it was believed, would turn around a stagnating economy.

The performance of consumer prices in the United States between 1890 and 1979 is shown in Exhibit 2. The consumer price level had been fairly stable and rising at a steady rate until the year 1915. From then on, it climbed quickly during the remaining years of the First World War and beyond until the year 1920. It started to drop suddenly but did not return to what might have been the expected level, indicated by a dashed line in the graph. Since the quantity of money in the system was functionally and institutionally related to the price and the quantity of gold produced, an official increase in that price would have meant an increase in the amount of money available in compensation for the decrease in real money which had occurred when the price level remained higher than desirable. The adjustment came, though only after the disaster, and when the price

Exhibit 2

U.S. Consumer Price Index For the Years 1890 to 1979

(1967 = 100)



Sources: U.S. Department of Commerce, Historical Statistics of the United Bureau of the Census, part 1, Washington, D.C., E-135-173, p. 211, Statistical Abstract of the United States, 1978, Washington, D.C., Table No. 792, p. 490;

U.S. Department of Labour, Monthly Labour Review, June 1980, Bureau of Labour Statistics, Washington, D.C., Table 79, p. 85.

of gold was changed to \$35/oz., it was too late to be effective!

The essence of the gold standard had been that it provided stability to prices and to trade flows in international commerce. It was, in economic parlance, a mechanism to maintain a balance between exports and imports of goods and capital: an equilibrium system. Indirectly, it also enforced a kind of a discipline upon spending units, including governments, in the sense that excessive spending would lead to large purchases and imports from abroad which would ultimately entail rising interest rates and the outflow of gold. Credit would be restricted in the losing country, and the economy would be forced to adjust.

This system disappeared with the start of World War I and it was later replaced by a system of managed, flexible exchange rates. The new system worked in a way that whenever a country experienced a balance of payment deficit, it tried to shift the burden of adjustment on the rest of the world and it was marked by a continuous process of competitive currency devaluations. It was, therefore, undesirable, since it did not provide certainty of expectations. It was risk prone. In essence, it did not improve the good climate necessary for a smooth functioning of international trade and relations among nations.

Then, the second disaster struck: World War II. When the war ended, the world emerged with all trade relations in shambles. A new system of international financing had to be created. This happened at Bretton Woods in 1945, when the

International Monetary Fund was founded to service the credit needs of a finance-hungry world. This did not mean a return to the gold standard! Instead, a gold-exchange standard was established with two key currencies as the main reserves - the resource vehicles exchangeable into gold. These two currencies were the British pound sterling and the United States dollar. They were declared to be as good as gold. Countries could purchase gold only by purchasing either British pounds or U.S. dollars with which they could obtain gold certificates. These certificates were sold mainly by the U.S. Treasury and could be redeemed in gold. At the same time, all members of the IMF agreed to adhere to a fixed exchange rate system. The rate at which each country's currency was fixed had been set by the number of units of the national currency which could be exchanged for one U.S. dollar. This value could fluctuate up and down by plus or minus 1 percent. At the same time, the U.S. dollar remained fixed at \$35 for an ounce of gold.

Since international trade is a function of many factors, imbalances could be expected which would place considerable strain on currencies affected by such imbalances. For this reason, provisions in the agreement allowed for adjustment of these exchange rates according to specified rules. In short, this was called the adjustable, pegged rate system. The world financial situation at that time was such that no other international acceptable currencies existed except the U.S. dollar

and the British pound. The U.S.A. had a gold reserve of about \$30 billion in gold at \$35/oz. which covered its notes by over 50% when only a 25% gold coverage was necessary. The U.S.A. could afford outflows of funds and credit in support of war-ravaged economies. Generously, the United States extended credit, starting with the Marshall plan and followed by more and more foreign aid. The U.S. did not mind a deficit in international payments and it supplied funds to a money-hungry world. The U.S. dollar was in demand and the deficit that ensued after 1957 was a so-called 'demand deficit',⁵¹ reflecting the demand for reserve growth by the rest of the world. It meant that, in total, the U.S.A. provided resources for the world. However, take note that its balance on current account was still positive.

As time passed on, the size of the international deficit increased as the current account surplus decreased. Slowly, more and more U.S. dollars found their ways into the hands of non-Americans who welcomed these reserves. But soon the time came when the outstanding balances grew incessantly and they became larger than the U.S. reserves in Fort Knox necessary to back the domestic notes at 25% in gold. Slowly, they had dwindled to about \$10 billion at \$35/oz. By then also, the current U.S.A. account moved into the red. Foreign residents saw themselves holding more \$ U.S. than they wanted and they

tried to unload these dollars. The demand deficit had changed into a 'supply deficit', and, with the increased dollar supply, the demand for other currencies emerged. The need for an internationally acceptable medium of exchange had ushered in a period of ample dollar supply which destroyed the confidence that had made it internationally acceptable. That was the fault of the system and cannot be pinned on the United States.

What followed was quite predictable. The pressure normally exerted on other currencies reverted now against the key currency itself in demand for a depreciation. This would have called for a devaluation of the U.S. dollar in terms of gold, which, initially had been declared to be as good as gold with \$35 an ounce. This pressure on the basic relationship of the key currency meant that the relationship was totally out of balance, or in disequilibrium in respect to gold and the other currencies. The international monetary system evolved into a condition of chronic instability. Since the U.S. dollar had been declared as good as gold at \$35/oz., it was impossible to change this currency value in terms of gold without major economic repercussions. At that time, any suggestion to this effect was equivalent to "sin". Therefore, first the \$ U.S. was fixed in terms of other currencies and the U.S. had to support it, and second, the \$ U.S. was fixed in terms of gold.

These fixities prevented adjustment via the price mechanism. Any return to an international payments balance other

than through the price mechanism would have required drastic reductions in domestic expenditures in the U.S.A. (to curb the deficits). This, the U.S. was unwilling to undertake in the early 1970s. Therefore, the system was unstable and disequilibrium prone.

Finally, there was a critical third factor, viz. the existence of the so-called Euro-dollar market to which had to be added later, the Asia-dollar market. The existence of these monetary institutions proved to be more devastating for the American dollar than people are willing to see. The point is that these markets deal in dollar-denominated deposits which grow in a geometric progression.

A dollar-denominated deposit is a deposit of a U.S. dollar cheque with a bank outside the U.S.A. - i.e. in Europe - but drawn on an account in a U.S.A. bank. These balances of the depositors - let us say of a European exporter - are now a liability of his bank towards him, while the original dollar balances are at the disposal of the bank. The bank may now sell these balances in the foreign exchange market where they are picked up by the Central Bank; or they may be lent out to the public. Let us assume these dollar balances enter a European Central Bank. From there, the deposits move perhaps to the Bank of International Settlement in Basel and, from there to London, where another European manufacturer, under tight credit conditions at home, may borrow these funds, and sell them

to his bank for national currency. In turn, the bank deposits these funds for a second time with the same Central Bank, which again has to buy it to support the exchange rate. In this way, monetary base is increased twice by the same dollars!

Thus, a vicious circle exists which is generally recognized among the international trade economists.⁵² Today, this operation is generally known as recycling.⁵³ The consequence is that dollar deposits of non-Americans are several times greater than the sum total of all international payments deficits encountered by the U.S.A. since 1957!⁵⁴ It means that Europeans, and Canadians for that matter, who have \$ U.S. balances with their commercial (chartered) bank do not realize that their deposit may just be a redeposit of a previous transaction. It means that one U.S. dollar has created more than one U.S. dollar deposit liability. In short, an abnormally high overhang exists of \$ U.S. denominated deposits against actually existing dollar-balances 'anchored' in the U.S. banks. It is the volume of these dollar-denominated deposits which increasingly reduce confidence in the U.S. dollar. The tendency is to trade these deposits for gold and other currencies. This pressure to exchange U.S. dollars for other currencies started the revaluation of the U.S. dollar in terms of gold. Countries such as France for instance, became very keen on trying to buy gold certificates and translate all these dollar balances into gold at the going price of \$35. By agreement, the U.S. was obliged

to do so. When finally after much turmoil in the exchange markets in the early 1970s, it was recognized that the American dollar-note coverage was about to go below the official 25 per-cent gold reserve requirement, the mad scramble for gold in exchange for dollars started. The "Gold Window" was closed. The U.S. dollar had become inconvertible into gold! This happened in 1971.

The Smithsonian Agreement followed in December of the same year. For the first time, the U.S. price of gold was adjusted upward to about \$42/oz. The gold-exchange system, which had broken down earlier that year, was officially dead. To avoid the problems of such a lame-duck currency, which once was supposed to have been as good as gold but which had succumbed to the pressure of the same system that had made it that good, a new international reserve substitute was created: "paper gold", or, in official terms, special drawing rights; they are a new means of international payments. Still, the U.S. dollar had a fixed value in terms of gold, but it was meaningless, because officially, dollars could not be converted into gold any longer; and there were lots of dollars looking for gold!

On the domestic scenes of the U.S.A. and in the countries of the Western World, another phenomenon made itself felt. The word was "deficit spending" as a fiscal policy to monitor high-level economic performance. Monetary accommodation by

borrowing from the Central Banks led to expenditures and demand for cash-balances. These increases in demand, starting at the top with all levels of government and ending at the lower end with the pennies the kid was handing up to the cashier at the corner-store in exchange for jellybeans, had the generally startling effect that the price levels started to rise. Money was easily available through reserve creation and the more that was asked for, the more was created. If Central Banks initiated periods of tight money, the Euro-dollar (-currency) market satisfied any financial need.

Monetary policy was not effective. The interaction of these forces of prices and money is generally interpreted through the quantity theory of money, the oldest of all economic truisms. If the quantity of money goes up by X percent without any increase in output, then the price level increases by the same X percent. The price level is inflated by pumping money into the system; and the more you pump - or the more you spend on deficit - the faster the merry-go-round goes - and the higher the price levels will be.

In the United States, prices started to take off after 1967 (Exhibit 2). This meant also that the prices of their exports rose in a similar fashion. This was not taken lightly by the customers of the United States who had to pay high prices for manufactured goods with the U.S. dollars which they had earned by selling their goods and raw materials at low prices;

the commodity most crucially involved was to become: oil. Each barrel of oil brought less in real return to the selling country. The whole political problem in the Middle East aside, the petroleum exporting countries were discontent with their real export earnings and they formed a cartel, "jacking up" the price of oil! This rise in oil prices led to an ever-increasing deficit in the balance of international payments. The volume of U.S. dollars supplied on the foreign exchange markets rose drastically, leading, due to the recycling phenomenon and other stabilization actions of the various central banks, to an unprecedented monetary expansion in the entire world. This brought about an unavoidable global price inflation as a consequence. The petroleum exporting countries, realizing their chance in the international money game, subsequently accelerated their demand themselves. The pressure increased. Early in this game, the only economic answers would have the adjustment in the American economy via the income expenditure mechanism: cut expenditures, reduce imports and trim the outflow of dollars which, if they do, are redeposited n-times over.⁵⁵ That point in time was 1971, as hindsight tells us.

Unfortunately, the present international monetary system does not have the fundamental fortitude or discipline as the old gold standard had. Why did the old gold standard have more discipline than the present pseudo-system? The answer is almost platitudinal, although it is somewhat couched in an economic law. The man who spelt it out clearly was an economist of the 19th

century: Cournot, and the law is named after him: Cournot's Law.

Under the gold standard, all outstanding balances were settled in gold such that the system for all countries had to show a zero balance among all countries. However, it could be greater than zero by the additional amount of (new) gold that was put into that entire world financial system of the gold standard.

Where, then, did the gold come from? Well, the Canadian mining industry knows; and it was not easy to supply this additional gold. A corresponding amount of labour and capital went into its production and the scarcity of all available factors imposed the limit on production of gold and the growth of international trade. Today, Cournot's Law still holds with the difference that the imbalance made possible by the addition of gold (and conversely its contraction as in the 1930s) has been replaced by pure credit creation. Slowly but surely, world imports exceeded annual exports financed by additional credit (money) creation. This is brought out in Table 11; the world import imbalance means the creation of credit for that year. It leads to higher exports in the following year and, in turn, to even higher imports thereafter. The significance of this phenomenon becomes even more visible by a five-year cumulative total.

TABLE 11

Free World Exports and Imports
Balance on Current Accounts
And Gold Stock of the International Monetary Fund
for the Year 1950 until 1979

Year	Exports billions of \$U.S.	Imports billions of \$U.S.	Balance Negative	Gold Stock millions of Troy Ounces
1950	57.1	59.0	1.9	951.99
1951	77.4	81.7	4.3	957.53
1952	74.5	80.4	5.9	958.06
1953	75.6	76.7	1.1	969.23
1954	77.8	79.7	1.9	987.25
1955	84.9	89.2	4.3	999.90
1956	94.6	98.5	3.9	1024.48
1957	101.5	108.2	6.7	1059.38
1958	96.7	101.1	4.4	1079.67
1959	102.6	107.3	4.7	1078.88
1960	114.6	120.2	5.6	1083.30
1961	119.8	125.8	6.0	1107.27
1962	125.2	132.8	7.6	1118.84
1963	137.4	144.6	7.2	1149.00
1964	154.0	162.2	8.2	1163.30
1965	167.1	176.2	9.1	1193.59
1966	183.6	193.9	10.3	1165.02
1967	192.7	203.4	10.7	1125.52
1968	215.2	226.5	10.9	1106.57
1969	246.6	258.2	11.6	1112.06
1970	283.7	297.1	13.4	1056.83
1971	317.4	332.1	14.7	1026.14
1972	376.8	389.2	12.4	1017.43
1973	524.2	536.1	11.9	1019.72
1974	773.3	785.6	12.3	1018.41
1975	796.5	814.4	17.9	1017.41
1976	906.8	924.3	17.5	1012.64
1977	1029.9	1060.6	30.7	1014.87
1978	1188.6	1231.3	42.7	1021.88
1979	1507.8	1544.3	36.2	929.96

Source: IMF, International Financial Statistics Yearbook 1979, 1980, Washington, D.C., p. 40-41, 64-67.

The annual international trade deficits

	:\$ billion
1950-54	- 15.1
1955-59	- 24.2
1960-64	- 34.6
1965-69	- 52.6
1970-74	- 64.7
1975-79	-145.0

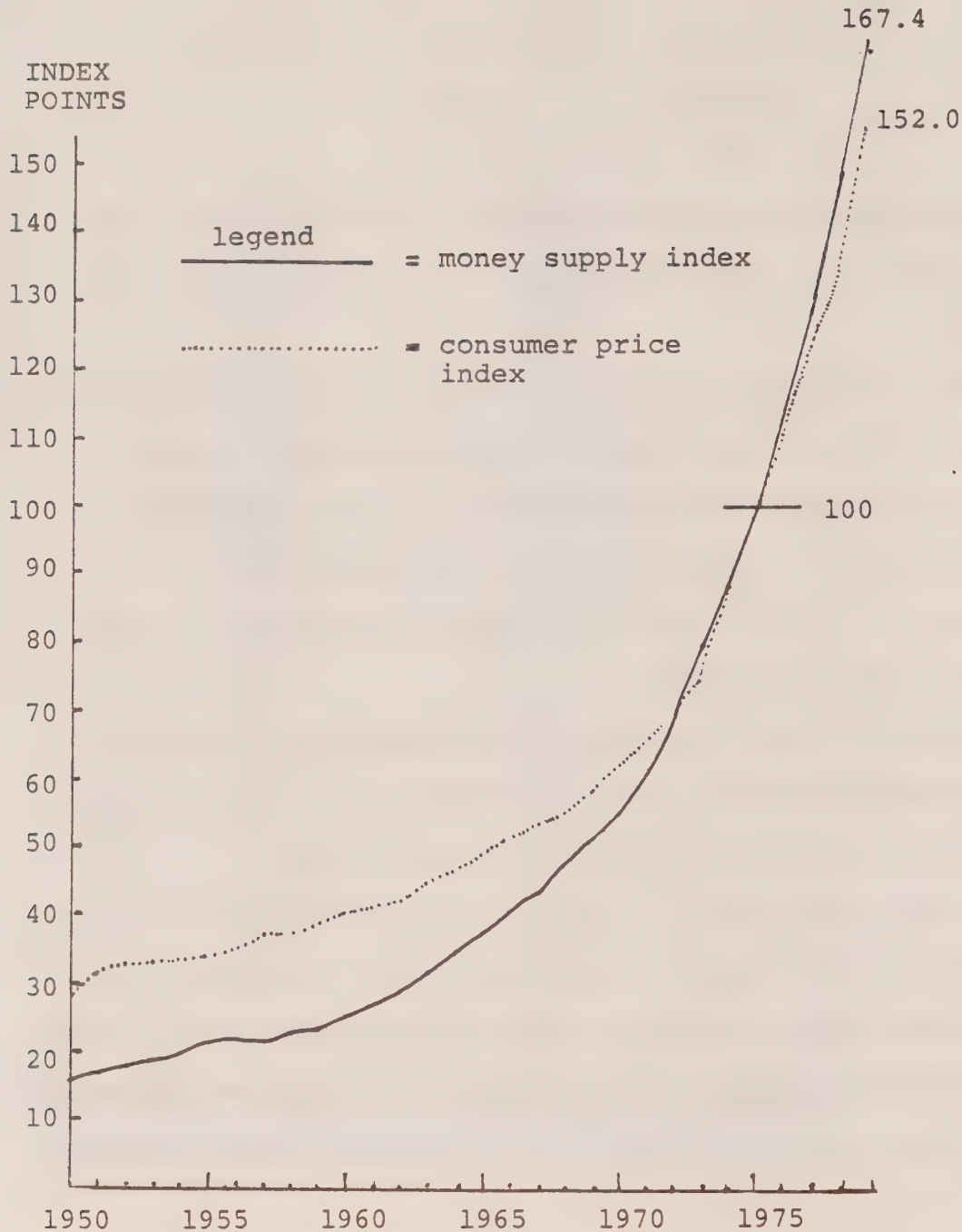
This breakdown shows that credit creation in the last five-year period was ten times larger than in the first five-year period.

These imbalances mean only that the corresponding amount of new deposits have been created. Recycling swells international money supply even more severely. The consequence is obvious: inflation. Exhibit 3 is to demonstrate the close relationship. It shows the almost synchronized rise of world money supply and world prices.

The more the OPEC countries increased their prices, the worse the imbalance became, the more money was created, and the faster was the acceleration of prices in the world.

In this inflationary climate, as all prices adjusted upward, including the interest rates, one crucial commodity had been left out: gold. By leaving the price of gold tied to the U.S. dollar until 1971, and then adjusting it but insufficiently, and when finally combined with the unbelievably large increases

Exhibit 3
World Money Supply and
Consumer Price Indices
for the Year 1950-1979



Source. IMF, International Financial Statistics, Yearbook,
Washington, D.C., p. 57, 61.

in international means of payments, the gold price had to be catapulted out of its disequilibrium situation as it eventually was. The rest is recent history.

That it overshot its proper equilibrium is quite clear and when it will have found its economic equilibrium level - provided political disturbances do not harass it again and again - then the general future behaviour of international price levels will determine its movements in no uncertain degree besides the basic economic forces of demand and supply for gold. They are discussed in the next section.

Two final points should be made at this juncture: one concerns the equilibrium level, and the other the prospect of expenditures constrained under the Reagan administration in the U.S.A.

In July of 1980, the South African authority announced that it would no longer sell the gold as it was produced and supplied.⁵⁶ The undertaking was to stabilize the price of gold at the \$600 level. The Central Bank of South Africa which controls the release of gold produced in that country's mines would temporarily cut off the supply if gold prices were sagging below that level. This was interpreted by members of the Canadian gold mining industry as a fortunate sign that, at last, one country was controlling the gold price and would bring about certainty in the future of gold prices and markets. The advantage for the industry would have been to be able to plan ahead with

a much greater degree of certainty as the risk element would have been reduced considerably. The behaviour of the gold price, however, has not born out this hope. As political tension subsided, the price level moved down towards its real economic equilibrium level.

The second point refers to the planned cutbacks in expenditures in the U.S.A. They are a welcome sign of hope that the inflationary danger finally will be tackled. It will be done in a gradual way as many economists recommend as a possible and feasible solution without necessarily causing deflation.⁵⁷ Nonetheless, real and great care is required in the management of this delicate problem. Over time, the international payments deficit will, hopefully, be reduced gradually. One thing that is not recommended in this case is to aim at a U.S. balanced payments surplus. It would mean a total reversal from a supply-deficit via a demand deficit to an overall surplus. The havoc it would create in world financial markets would be beyond description as the excessive dollar denominated deposits have to be honoured with real U.S. dollars. This would mean a surge in demand for U.S. currency and the U.S. dollar would appreciate dramatically versus the currencies of the deficit countries, the undeveloped countries suffering the most. The final scenario is left to the imagination of the reader; for the gold mining industry, it would mean a collapse of the price of gold. The world would suddenly face a depression situation which would

be worse than the world currency reform which stands at the end of the road if the money stream is not cut back. Only a gradual but determined policy will prevent any of these disastrous alternatives. Yet, the road to fiscal and monetary sanity will not be an easy cure for the world as a whole. The worst effect will be for those who live under the widely advocated suggestion "to learn to live with inflation". Many people may not be willing to pay the price of shattered inflationary expectations, because they cannot see what is at the end of the road.

SECTION VI: GOLD IN THE FUTURE: THE ECONOMETRICS
OF PRICES AND SUPPLY

Preamble: The authors of the report caution against accepting the stated figures for the future output and, especially, for future prices of gold as a basis for investment decisions. They themselves question the validity of several points of the model and decline any responsibility for damages of individuals incurred by reading more into the statements and figures than is actually meant and explained in the following discussion. This section of the report is nothing but an honest attempt to explore and discuss, on the basis of the most efficient means economic science can muster, as intelligently as possible, the outlook on gold. In the process of the analysis, certain difficulties were encountered affecting the results. These are data problems, methodological aspects, external factors and a general instability which pertains solely to gold.

Data Problems

The statistics used in the econometric analysis are those available in United Nations publications, chiefly in the Statistical Yearbook. For 1978 and 1979, the ABMS, Non-ferrous Metal Data 1979 was consulted. These two sources are not entirely consistent, but at least they were highly compatible in the information they provided. A problem that arose in this context was

that the U.S.S.R. was included only in the last two years, and for reasons of consistency, the significant figures of Soviet gold production had to be deleted. Therefore, the econometric analysis only accounts for a world of gold without the U.S.S.R.

Another problem arises from the unknown magnitude of statistical measurements and reporting errors. These errors may emanate from summary statistics of all countries who are known to be gold producers but do not publish production figures. For these cases, even the United Nations statistical offices have to rely on specialty agencies and institutions which then provide the data to the best of their abilities.

In this respect, an additional serious defect mars the production picture. This defect lies in the unknown size of illegal gold operations which evade any statistical appraisal. One case in point is the generally known activity of high-grading. Another is smuggling, both of which reflect obvious and strong undercurrents in the world gold markets. These occurrences cannot fail to affect the pricing behaviour of this particular metal. The previous discussion of Brazil and the events in the gold mines in the Phillipines definitely support this argument.

Moreover, the existence of a definite global gold stock of which about only half is accounted for, must in no insignificant manner, influence the market performance of gold. For

instance, significant amounts of species may, at one time, be pushed into the international gold market when prices are high. Their previous holders try to take advantage of a very favourable gold price. These participants, besides the known international financial institutions, and the other known private gold holders in the world, include even religious institutions as noted in the case of India.

For these obvious reasons, the statistics cannot be called pure, but they were the best possible available to the public, and us! However, of these, some important flaws may not be as critical as one might assume at first sight. They need not affect the results of the analysis. Take, for instance, the example where the production of a country has been excluded. The case is the Soviet Union. It can easily be argued that the addition of the U.S.S.R.'s gold production would amount to a certain proportion of world output. If this proportionality argument is accepted as true - and this point can be defended very strongly - then only a proportionate, annual upward shift in output would take place and the results would not be otherwise affected. This is so because the analytical econometric model is of a logarithmic-linear variety. However, there are those extraordinary events which cannot be foreseen as huge, new gold discoveries will unquestionably happen in the years to come. The econometric analysis does not and cannot

take account of these possibilities. Nor can the model include the changes in gold production as discussed, particularly with respect to China or Brazil. These values cannot be validly incorporated because some of these values proposed for adjustment are highly conjectural. In short, statistical impurities exist!

Methodological Aspects

At first, the two dominating exogenous variables are the GDP growth rate for the world excluding services; and the other, the time factor which has become a proxy for technological change. No problem exists with the latter, but it is important to point out the critical role played by the former.

Since it is impossible to forecast with any degree of reliability the growth of the world economy for the next twenty-five years after 1979 on a year-by-year basis, the decision was made to use only one series of specifically extrapolated growth rates, taking into account the change in the magnitude of the industrial and agricultural components on the one side and that of the excluded service sector on the other.

This exclusion was necessary, as has been pointed out in Chapter I: Forecasting World Mineral Prices, Production and Consumption, because produced minerals are consumed in the process of industrial production where they are used as inputs. In this respect, they do not have any direct impact on the service

sector of the world economy.

After a discussion with Dr. Walker of the U.N. Statistics Section on World Product Forecasting, the GDP growth rates thus computed from the basic data obtained through the courtesy of that office can only be considered reasonable assumptions. Dr. Walker pointed out that the Secretariat-General of the United Nations declines any responsibility that the given growth rates of the past will be valid and true to continue into the future. The authors of this report concurred with Dr. Walker on the impossibility to make projections so far into the future and to expect them to reflect accurately the future events. The growth rates are one set of exogenous variables and are assumed to be of that magnitude. This is a point which has to be stated explicitly to avoid misunderstanding.

Several implications derive from the size of annual growth rates which have been set to be over 5 percent annually. They shall be discussed here:

- a) It is quite possible that, from the present point of view, these growth rates may be much more relevant than one is inclined to accept if the reader lives in a recessionary economy such as prevails on the North American scene at the time of writing;
- b) regardless of the personal views of the authors of this report, these rates may, in reality, turn out to be different. If this is the case, then the

ex post results must differ from the forecast; no question about it! However, the researchers saw no purpose in carrying out a sensitivity analysis which would not have delivered any more credible results because the argument would move on to how to decide on the selection of their real growth rate which otherwise could be expected!

- c) As was pointed out clearly in Chapter I above, the basic economic setting is one of economic dynamics using a short-run standard, competitive price, demand and supply equilibrium framework to trace past and future behaviour. This means that short-run (annual) prices, production and, where available, consumption figures are functionally analysed to produce long-run (secular) results. Adjustments of a variety of factors are, therefore, not made explicitly, but only implicitly. In other words, the model cannot do certain things for which it was not designed, such as taking into account discoveries of new significant ore bodies, smuggling and other disturbances entailing significant deviations from the norm. For instance, the potential gold output of Brazil cannot be taken into account.
- d) Furthermore, daily operations and events which elec-

trify the commodity markets are taken into account only as far as they transmit signals into annual prices. Thus, daily movements brought about by changes in confidence, daily news information, exchange rate conditions and the whole complex of continuous, daily adjustments in expectations with respect to present and future market conditions, prices and inventories are only reflected in annual data; the assumption can easily be made that most of them cancel each other as many facets are stochastically determined and that only the economically significant aspects find expression in the annual figures.

External Factors

In the attempt to trace out the unbiased economic behaviour of the various variables, especially that of the price of gold, external factors influence the picture. Mostly, they are political in nature and of chiefly transitory significance. As political tensions are mounting, prices are driven up; the eventual subsidence to a more peaceful situation will lead to a sublime decline in both prices and tensions, and to a return to economic reality. Spells marked by a lack in confidence in a particular currency, particularly when this currency is the United States dollar, will have similar effects in an upward direction. Mostly, political

tensions and currency weaknesses go hand-in-hand. The prices of gold are moving up quite quickly, but after a return to world monetary confidence, they will decline finally though mostly in connection with a higher level of interest rates.

Therefore, the model has certain limitations. In other words, what cannot be measured or replaced by econometric dummy variables cannot be analysed. Consequently, that which cannot be included in the analysis cannot be expected to pop up as a result! In spite of this dilemma, there is great stability in the performance of these metals as explained in Chapter I. This stable behaviour in itself is an indication that the world mineral market is much more competitive than is generally and readily admitted. This even holds true when the so-called non-capitalistic U.S.S.R. is included in the analysis. Therefore, for the ten metals investigated, the market and price performances are surprisingly very stable. This confirms a similar observation made by another Canadian economist.⁵⁸

Model Instability: Gold, the Exception

However, among all the metals analysed, there is one exception to the general stable performance and that metal is gold. For gold, the model is inherently unstable which means that the long-run results contradict basic economic reasoning. The instability over time results from the critical relationship

between price and quantities supplied (produce). This condition differs from the others. Normally, and this is the case for the other nine metals, the supply curve is upward sloping to the right. This means that following an increase in the price of the metal (the independent variable), an increase in the quantity produced will be brought forth by the existing mines. This is exemplified in Exhibit 4a) where the shift of the demand curve D_0 to D_1 leads to an increase in p from p_0 to p_1 , and the quantities produced change from q_0 to q_1 . Now, the markets are theoretically cleared at point E_1 instead of at E_0 . The increase in price due to an increase in demand has led to a larger output. That is the normal situation.

In the case of gold, the reaction is perverse. This is explained in part b) of Exhibit 4. The supply curve, instead of sloping upward to the right, slopes upward to the left at a somewhat steeper angle than the demand curve. As demand now shifts to the right and the market moves to a new equilibrium from E_0 to E_1 , two different reactions can be observed: at first, the price jumps much higher than in the first case (Exhibit 4a)) and, second, the quantity produced becomes smaller as q_1 is now to the left of q_0 . The reason is obvious to the gold mining industry: when the price is sufficiently high, it pays to move men and machines to leaner ore bodies which could not be exploited before. The same machinery will then work - let us say - just as hard as on the previous ores but the real

Exhibit 4

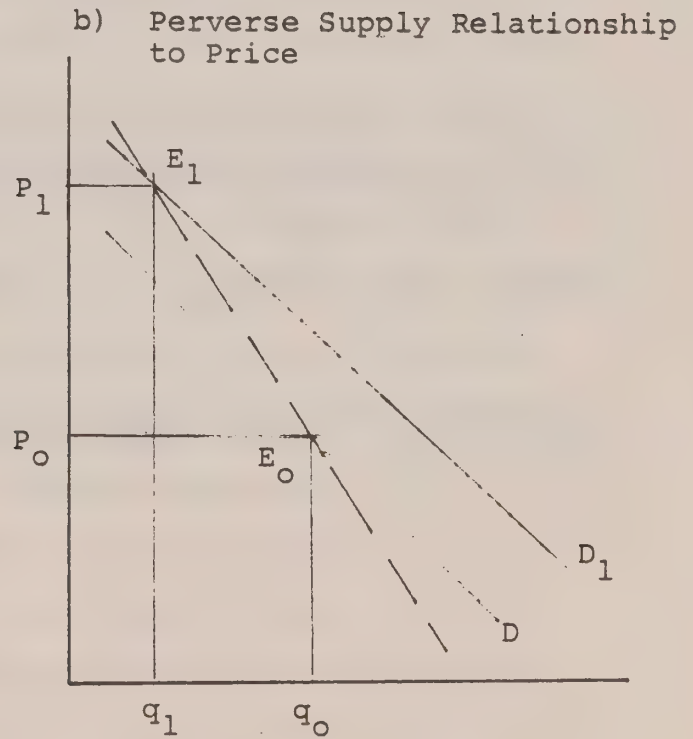
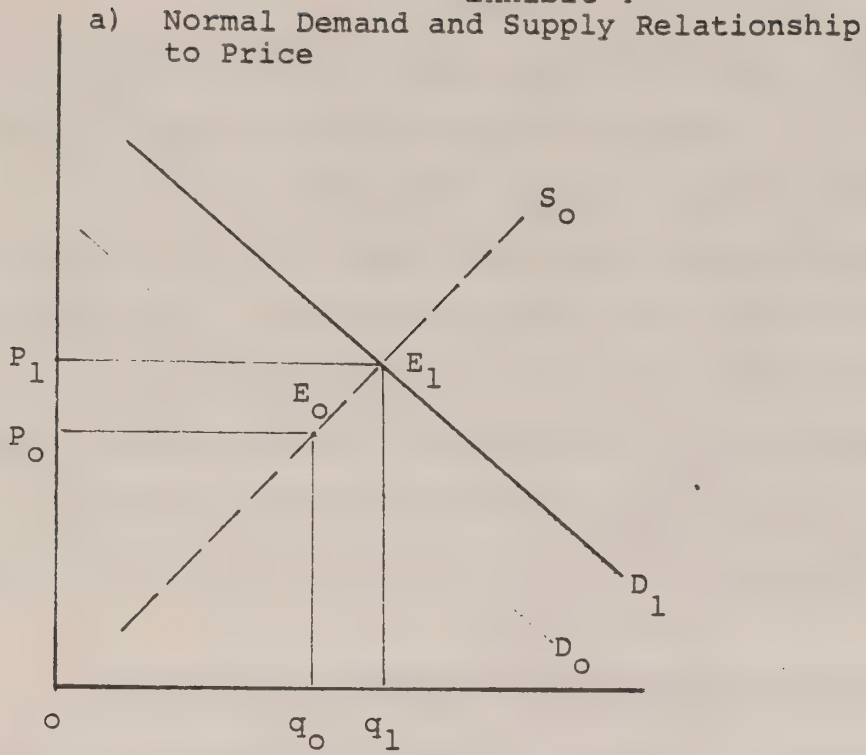


Exhibit 4

c) Small Shifts of a Negatively Sloped Supply Curve

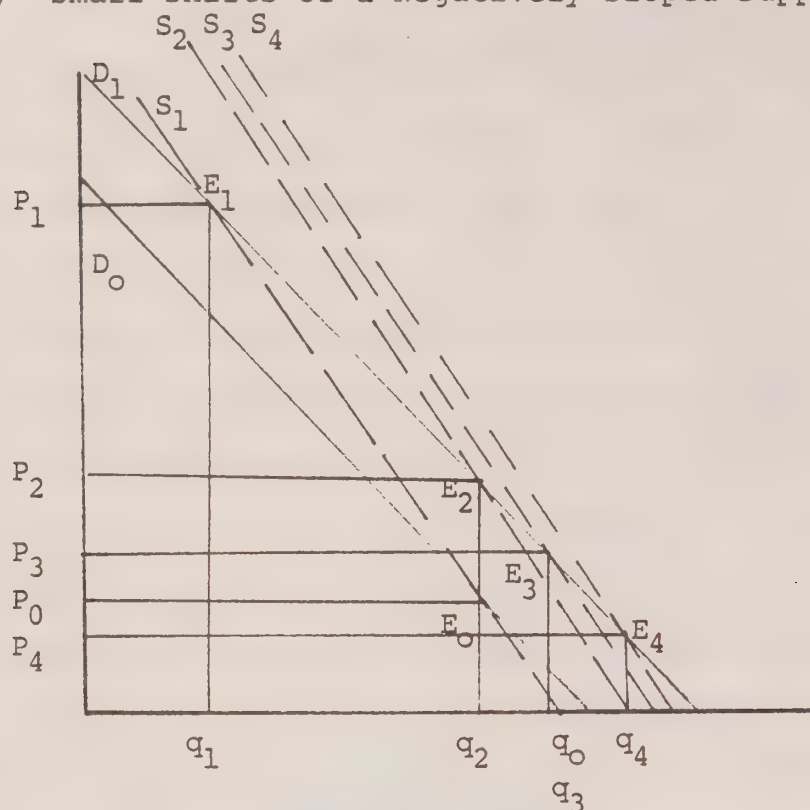


Exhibit 4 (a, b, and c) serves as an explanation. The values established in the econometric analysis on page 24 of Chapter I are:

Ordinary Least Square

$$P_t = -.104$$

Two Stage Least Squares

$$P_t = -.112$$

This means that a 10 percent increase in the price of gold would lead to a 1.04% and a 1.12% decrease respectively in world gold output.

return in terms of gold output must be lower. In economic terms, the quantity supplied has decreased.

It is quite possible that this unusual phenomenon has been at work in Canada under the Emergency Gold Mining Existence Act . This act provided subsidies to mines if the cost of production of gold was in excess of \$26.50/oz but not greater than \$38.33/oz. According to the Act mine operators were assured a subsidy of \$5.52/oz as a maximum which was raised to \$6.90/oz for the years 1958 to 1970.⁵⁹

Exhibit 4c) carries this argument one step further. If then, new mines are opened up, the supply curve shifts to the right. The result of this shift is at first shown by the new supply curve S_2 . Here, a substantial increase in output is noticeable as the equilibrium moves from point E_1 to E_2 . Simultaneously, the price has fallen sharply from p_1 to p_2 . An additional, though small, shift in supply to S_3 will deliver the same quantity to the market as at E_0 but at a somewhat higher price p_3 . If the mining industry becomes very optimistic about further prospects and increases the supply to S_4 , the new position at which the market is being cleared is at E_4 . The price is now P_4 , which is lower than it was at E_0 and a number of operators will be forced to go out of business if they cannot move over to a better grade ore. The only solution to this unstable condition is a persistent increase in demand

such that the demand relationship, due to increases in incomes, moves steadily to the right.

During the discussion of the various gold producing countries, it was observed empirically that a number of countries decreased their gold output with rising prices. Statistically the proof is overwhelming, especially when the simulation graphs of Chapter I are reexamined. Figures 4 and 5 demonstrate this unusual phenomenon beyond any doubt. As a matter of fact, during times when the real price of gold was declining - the current price was fixed - the quantities produced by the whole world were on the increase. In turn, when finally the prices started to move upwards, output declined and this happened over a ten year period.

Consequently, a very unusual situation exists if one has to look into the future of gold. As world output (GDP) and incomes rise, the demand (curve) will also shift to the right with an ensuing upward movement in the price of gold. The greater these changes in demand, the greater the rises in the price of gold will be, and the larger the reduction in mining output. That is what the model implies because that is the way the real world has behaved on the basis of the existing statistics. The prediction mechanism inherent in the model cannot be - wishfully - redirected to produce a more satisfactory picture of performance in the long run. That is why, in Chapter I, it has been stated that the values beyond the year 1990 are

unsatisfactory.

The Forecast of Prices and Supply

Table 12 and Exhibits 5 and 6 provide the projections until the year 2004 of both prices and quantities produced for the world as a whole except for the U.S.S.R. Evidently, prices and quantities forecast until 1990 do not appear to be outside the realm of the possible, especially since gold prices have already been over the \$800/oz. level.

Initially, the forecasts imply that the price of gold will return to much lower levels from those heights of the years 1979 and 1980. Eventually, however, the economic price will rise steadily until the year 1990 and perhaps even until 1992. After that year, an explosive price picture is drawn which had to be rejected on account of the prevailing instability conditions in the gold model.

The projections for output could be considered as somewhat more reliable beyond those years in the early 1990s. This is so because they tie in closely with the generally recognized conditions of diminishing productivity due to resource depletion. It was stated that after 1987, the output of South Africa will be declining steadily far into the 21st Century.

It is now time to modify the output projections in light of the previous discussion of producing countries. This

Table 12
Projected World Prices and Output of Gold
for the Years 1980 to 2004¹
(\$ U.S. constant 1979)

Years	Price \$/oz.	Output Metric tons
1980	307.24	946.31
1981	317.38	942.83
1982	334.20	937.36
1983	356.53	929.13
1984	384.31	917.95
1985	418.04	903.88
1986	458.57	887.09
1987	507.08	867.83
1988	565.02	846.35
1989	634.25	822.91
1990	717.06	797.79
1991	816.29	771.26
1992	935.45	743.58
1993	1078.92	715.02
1994	1252.16	685.81
1995	1461.96	656.18
1996	1716.85	626.34
1997	2027.53	596.50
1998	2407.42	566.82
1999	2873.50	537.47
2000	3447.20	508.59
2001	4155.57	480.31
2002	5032.99	452.73
2003	6123.16	425.95
2004	7481.81	400.04

¹Excluding U.S.S.R.

EXHIBIT 5

WORLD PRICE OF GOLD FOR THE YEARS 1980 to 2004

(in constant 1979 \$US/oz)

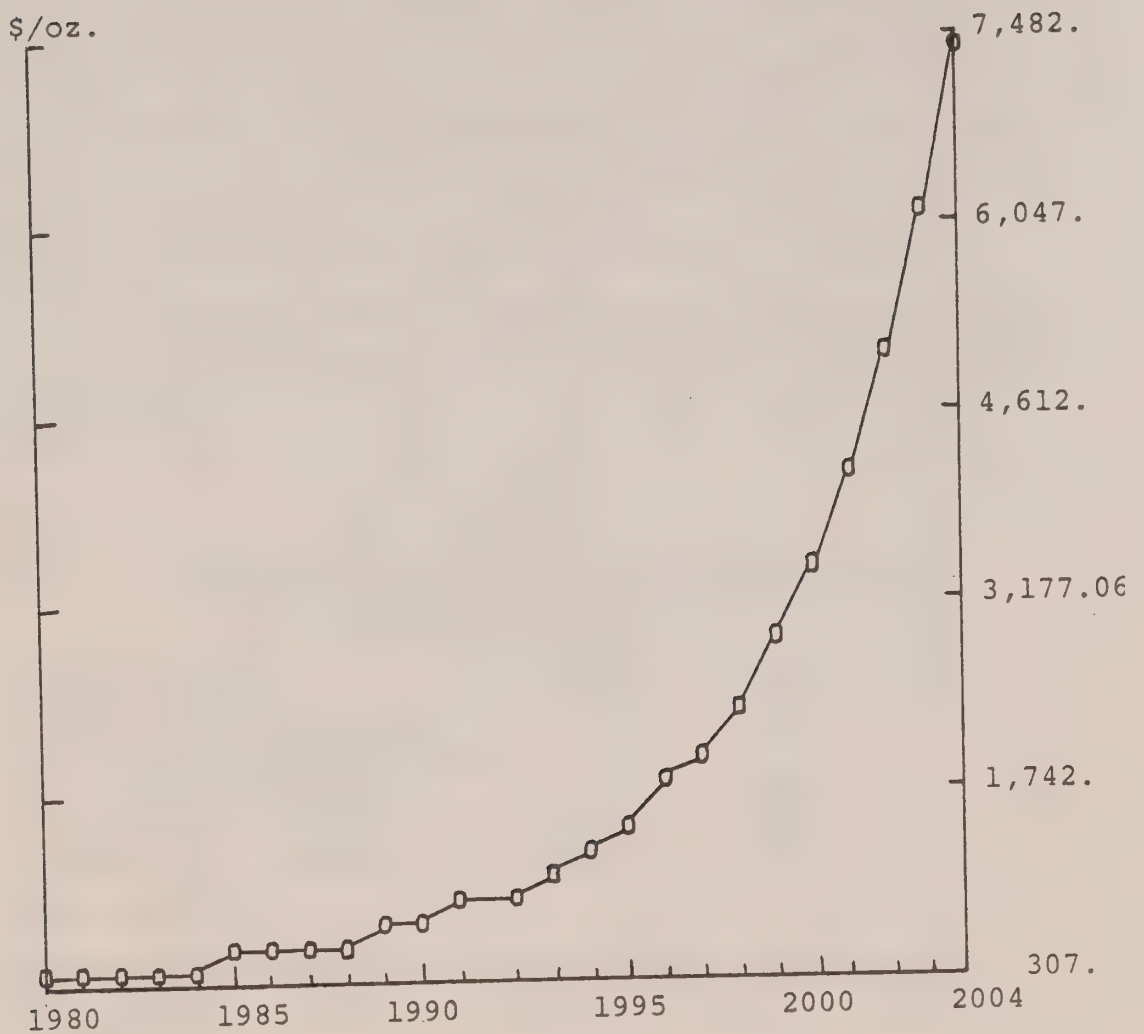
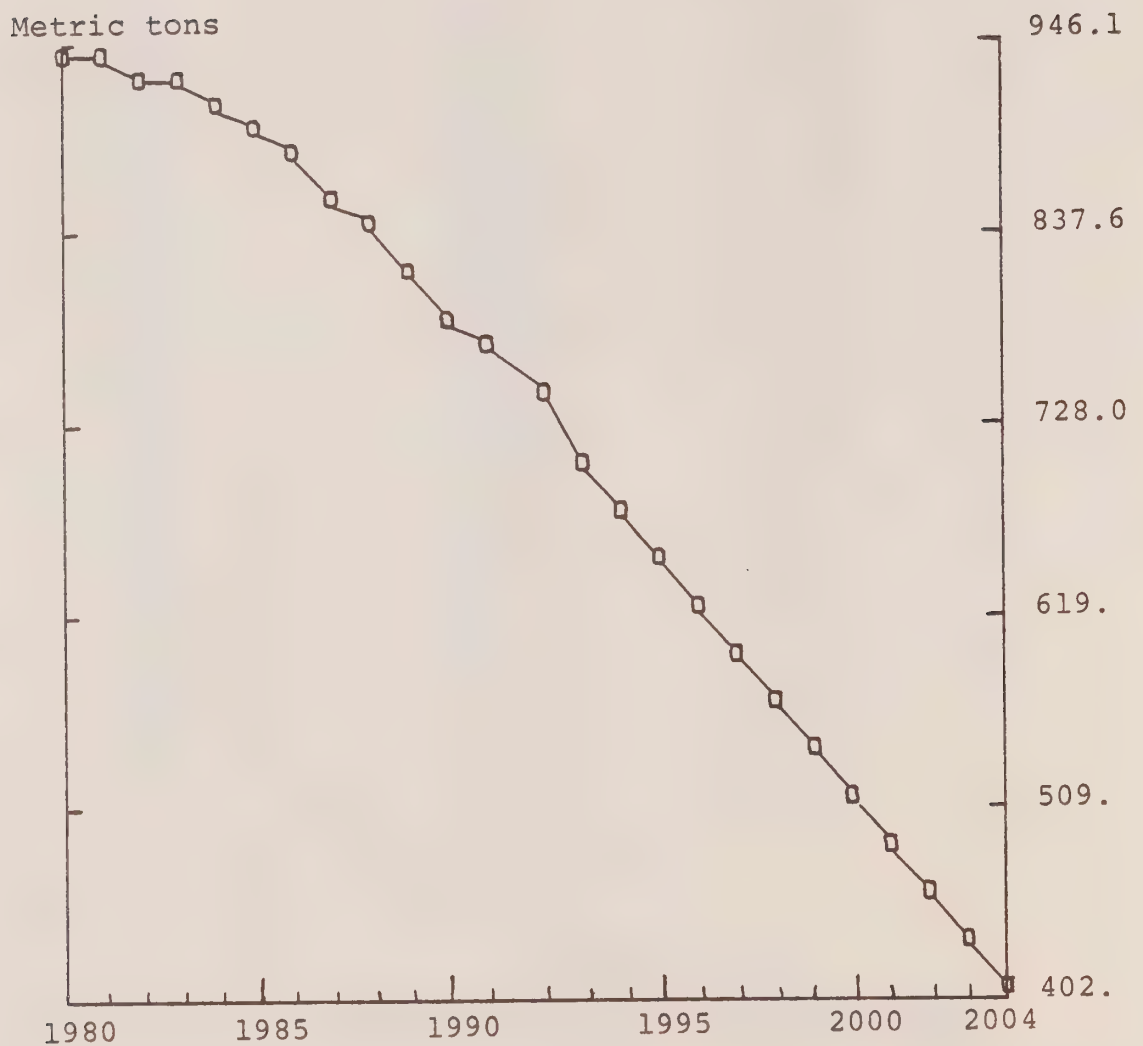


EXHIBIT 6

WORLD OUTPUT OF GOLD FOR THE YEARS 1980 to 2004 IN METRIC TONS
(excluding U.S.S.R.)



modification will be done for the forecast world gold output for the years 1990 and 2000, by adjusting it along the lines of the summary of alternative gold producers above.

At first, previously excluded and extraordinary expected production volumes of several countries will be added to the econometric forecast. Then, long-run shift quantities will enlarge the potential output even more. In making these adjustments, it has to be pointed out that there is no way to predict that far into the future with any degree of accuracy which gold reserves will be discovered in the many countries on this earth - except for the specific region under study. Therefore, the following modifications take the form of a "more or less educated guess" as the attempted adjustments are a matter of personal judgment, rather than the scientifically established truth.

Table 13

Adjusted Gold Output for the World For the Years 1990 and 2000 (in metric tons)		
	1990	2000
Projected Base	743	508
U.S.S.R. (excluded from the econometric analysis)	335	335
China (extraordinary)	50	100
Brazil (extraordinary)	150	150
Preliminary subtotal	1322	1093
Expected Growth		
U.S.A.	25	50
Phillipines	10	20
Australia	8	17
Canada	25	50
Total	1400	1230

The volume of gold produced by the Soviet Union is set arbitrarily at an average of 335 metric tons per year. Naturally, there will be deviations around the general values as also discussed above. Since these values are apparently open to criticism, there is no point in carrying this modification beyond the averages.

China will be included with a total of 50 tons by the year 1990, and with 100 metric tons by 2000; this country had also been excluded from the econometric model. Brazil is the extraordinary country with an average of 150 metric tons to be added.

For the U.S.A., the Phillipines, Australia and Canada, the expected additions to the present (1979) output until the year 2000 are the averages of the previously approximated values. The values to be included for the year 1990 are roughly set at half the increases in output until the end of this century.

South Africa has been excluded for any adjustment because it is the world's largest producer and included in the study. It is expected to see a decline in its output of gold to set in after 1987, which is implicitly accounted for by the econometric analysis.

In essence, it would appear reasonable that the level of world gold mine production would stand at about 1400 metric

tons by the year 1990 and at 1230 metric tons by the year 2000; the previous assessment set it at 1300 metric tons for the year 2000.

SUMMARY AND CONCLUSION

Summary

In summary, the statistics of world gold consumption suggest that approximately between two thirds and three quarters of gold is consumed industrially during those years and only between one third and one quarter is used for financial and investment purposes. To some degree, it is admitted, the demand for jewelry may also serve as a hedge against the world-wide depreciation of money.

The United States, apparently, is a user of decreasing significance for the small number of years under consideration. With the stable and larger use of gold in jewelry, nonetheless, the United States shows a smaller preference in the actual consumption of gold than the remainder of the world. However, it is recognized that the electronics use of gold by the United States is still more important than outside the U.S.A., while greater demand for dental gold exists, which seems to be still on the rise. Given the general prosperity in the United States of America, this only means that there are other things worthwhile in this world besides gold and money. The great United States commodity market produces highly attractive goods which are the substitutes for gold in a very wide sense of the term. If anything is an indication, then it is that the world demand

of gold for the electronics industry may be rising, though at a rapidly decreasing rate, as it may follow the technological development pattern set by the U.S.A.

The sum total of past world production of gold has been much larger than the known distribution of private and official holdings. Various institutions and events may account for the existing difference which can easily be just as large as the known holdings of over 1.8 billion ounces. However, any attempt to determine the distribution will remain, nolens volens, highly conjectural. What cannot be denied is that this overhang exists.

World gold production rose from 1950 until about 1970. After that year, it started to decline, at least for the world as a whole, excluding the Soviet Union. However, if the U.S.S.R. is taken into consideration, it is fair to say that the gold output of the world has not changed much over the past ten and eleven years. Both Canada and Ontario were once very important suppliers of gold, but their positions lost substantially in significance. In the world, South Africa and the U.S.S.R. are the two largest producers now, with Canada and the U.S.A. following in third and fourth positions respectively. Five other countries are relatively significant gold producers by delivering more than 1 percent each of world gold output. All others of about fifty-five "gold-digging" countries are of minor significance, although some held once more prominent positions. The reasons for the decline of most of these will

have to be seen in the depletion of minable ores and in light of the unstable behaviour of the econometric gold model. In recent years, Canada has reimported gold in alloy from the U.S.A. In net terms, the gold had previously been exported to the U.S.A. or to the Soviet Union which sold refined gold in large quantities to the United States. The world gold lode amounts to at least 5.4 billion ounces of which 1.9 billion, by 1975 standards, were still embedded in this earth with South Africa, the U.S.S.R., the U.S.A. and Canada as the main known resource holders.

South Africa will produce about 700 metric tons annually for a number of years, while the U.S.S.R. can be expected to mine between 270 and 400 metric tons per year. The U.S.A. should be able to increase its output to a minimum of 100 metric tons per annum, while Canada's annual output will move away from the present output of around 50 metric tons towards the 100 metric ton mark. Brazil, in turn, is the obvious spoiler, as official output records and unofficial production reports produce very conflicting output figures. However, its output may rise dramatically to 150 metric tons per year, if not even to 300 metric tons, as it may even hold 50,000 metric tons as reserve. Peru, the Phillipines and Australia will most likely increase gold production greatly, whereby the latter two can be expected to double their present gold production volume.

China may soon produce 50 metric tons per year, which will eventually climb to 100 metric tons. By the year 2000, world output of gold could be 1300 metric tons, and under more or less favourable conditions, 1625 or 1050 metric tons respectively.

The history of the price of gold is tied up closely to the international payments mechanism. As long as the gold standard was in operation, a fixity existed between gold and the various national currencies. Substitution by a competitive, flexible and managed exchange rate system and, later, by the new mechanism of the International helped to pave the way of the world economies to endure ever-increasing import imbalances. The situation has become chronic as these balances have never been settled in real terms. The outcome was a flood of credit which inundated the world financial scene, putting unbearable pressure on the price system. Inflation became, for the first time, a worldwide problem. This inflationary cycle was finally accelerated by the mounting deficit of the oil-importing countries with the U.S.A. the main debtor country. These tidal waves of credits, combined with political uncertainty, eventually jettisoned the price of gold from its previous gold-standard moorings, leaving the price of gold free and at the mercy of all possible market forces. In the process, it overshot its economic equilibrium level.

Given the statistical impurities arising from measurement, reporting and estimating errors, the price and production forecast encountered a fundamental instability condition. This invalidates the results of the forecast mainly for the years after 1990. However, prior to this year, the price of gold would experience a return to the real economic level of between \$300 and \$400 (in constant 1979 U.S.A. dollars) for the years between 1980 and 1985. Later in the 1980s, the price level may rise again to and above \$700. This does not exclude possible gyrations around this average trend. This information is presented without engagement on the part of the authors of this report. The econometric foresees a declining output which is generated by the model. This decline becomes increasingly steeper to end at 400 metric tons of world output by the year 2004, a performance which cannot be expected to materialize. Necessary modifications of the forecast follow the lines of the assessment of alternative gold-producing countries by including those special situations where countries had been excluded, such as the U.S.S.R., or extraordinary situations such as were observed to hold for China and Brazil. These adjustments place the world gold production at an average range of between 1230 and 1300 metric tons by the year 2000.

Conclusions

The following conclusions may now be drawn:

It would appear reasonable that the preference for gold is of smaller significance the wealthier the country as regards real income and the availability of consumer goods.

Furthermore, one half of the entire world gold stock is held by monetary authorities and private individuals and institutions whereas the other half is not properly accounted for. This total gold stock may exercise an influence on the performance of the gold commodity market.

Moreover, among the four largest gold producers in the world, the performance of Canada and the United States has been the worst over the last twenty years. In contrast, South Africa and the Soviet Union excelled in the field of gold production. In addition, Canada's performance in international trade of gold shows that Canada reimports gold in alloy form. This gold had been previously exported either in the form of ore, concentrates or refined metals to the United States. Canadian gold ore and concentrates were exported to the Soviet Union in the year 1978 and that refined gold may have found its way back via the United States because the U.S.S.R. has shipped large amounts of refined gold to our southern neighbour.

There are almost 60,000 metric tons of gold in ore form still in the ground which would last, at the present rate of production, for another 50 years. However, at one point in time in the future, the rate of annual recovery must decline as ore reserves must become exhausted. Should the rate of output reach 1200 to 1300 metric tons per annum, in the year 2000, the rate of decline may even accelerate in spite of some additional discoveries and the greater feasibility of exploitation of mineral resources, should the price of gold increase as expected.

For the first time in over a hundred years, the price of gold is now free to move and subject to all forces operating through the commodity market as never before. It is particularly prone to react to changes in the world political climate and to signals emanating from an unstable world financial system which, if unwisely managed, may head for disaster.

In the future, the gold price of the early 1980s will see a return to an economic gold price trend climbing slowly from \$300 per ounce to \$400 per ounce in constant 1979 U.S. dollars, with the daily prices of the commodity markets gyrating around this trend. Later in the 1980s, the real price will rise to about \$700 per ounce. A further view into the future is not possible because the econometric model breaks down for later years due to a basic instability of the model.

This instability condition derives from the unusual negative relationship between supply price and quantities supplied. On the supply side, the future picture could be interpreted as an underestimate as the year 2000 is concerned. When adjusted for excluded countries and extraordinary outputs of certain countries, the previous figure of 1200 to 1300 metric tons as a target figure is confirmed. This means more gold will be produced in the future and Canada may take part in this long overdue expansion.

NOTES

- 1) Gold is the native metal element characterized by the symbol Au and belonging to the system of isometric minerals. The term 'isometric' refers to classes of crystal systems which display 'four threefold axes of symmetry as body diagonals in a cubic cell of the lattice. It comprises five crystal classes or point groups'. See: Margaret Gary, Robert McAfee Jr., and Carol L. Walf, (ed.), Glossary of Geology, American Geological Institute, Washington, D.C., 1972, p. 376. Atomic weight, 197.2; Specific gravity, 19.2 to 19.4. In metallurgy gold amalgam is an alloy formed when crushed gold-bearing minerals are brought together with mercury. Occurrence in the earth crust is 3.5 parts per billion.
- 2) Numerous get-rich-quick schemes for gold mining the waters of the sea have eventually, as they had to, ended up in failure, with the entrepreneurs losing their proverbial 'shirts', and the creditors their stakes. The gold content of seawater is too low (average 0.05 ppb) for commercial purposes even at today's prices!
- 3) INCO is the outstanding producer through its polymetallic mining operations in the Sudbury Basin.
- 4) Any encyclopedia will provide sufficient information on the importance of gold in man's past!! In addition, see USBM, Mineral Facts and Problems, 1975, p. 439-440.
- 5) To the economist, it is all the more interesting that the visitor also receives a short course in history of economic analysis, i.e., substantial examples from the contributions of Adam Smith, David Ricardo and Sir John Maynard Keynes; this, certainly, at a most appropriate location!
- 6) Recently, artificial metals of even greater electric conductivity have been produced in laboratories by high compression of gases. Ref. Pamela Weintraub, "Ultra-high pressures leading to new Materials", American Metal Market, vol. 88, No. 23, February 4, 1980, p. 14. E.g. Hydrogene when submitted to high compression will form a new metal of super-conductivity. Furthermore, this pressured hydrogen has an energy content of 300 times that of airplane fuel. According to scientist David Kendall, cadmium sulfide will become a superconductor which will produce ultra-fast solid state switches. The USSR has obtained similar results with copper chloride. *ibid.*

- 7) Washington Newsletter Center, International Minerals/Metals Review, John K. Higgins (ed.), McGraw-Hill, 1980, p. 388.
- 8) This implies a slight upward bias for the percentage of dental use for the world.
- 9) The world total of gold used in electronics is likewise upward biased.
- 10) n.f. supra, n.7; also p.11.
- 11) This is taken from a seminar held by the combined chapters of Timmins and Sudbury of the CIM in Timmins on November 13/14 1980, where Dr. Kavanough was a guest speaker.
- 12) D.B.S. The Goldmining Industry 1949, Industry and Merchandising Division, 1951, p. B-6, and Statistics Canada, Gold Quartz and Copper - Gold - Silver Mines, 1977, Queen's Printer, Ottawa, catalogue 26-209, p. 5. According to this last statistic, Canada produced 157,321,641 oz. of gold until 1960. The total for 1961 until 1967 was, according to Table 4, infra, 821.3 metric tons, or 26,404,795 oz. with a total of 183,726,436 (one metric ton = 32,150 ounces). For the economic historian, the following Canadian Government publication is of great interest: D.B.S. Canadian Mineral Statistics, 70 Years 1886-1956; Mining Events 1604-1956. Queen's Printer, Ottawa, 1956, Ref. paper. no.68.
- 13) Martin A. Larson and C. Stanley Lowell, Praise the Lord for Tax Exemption, Robert B. Luce, Inc., Washington-New York, 1969, p. 229-230. in ref. to Alberto Cavalleri, The Changing Vatican, Doubleday, N.Y., 1968, cf. pp. 109-110.
- 14) It would not surprise at all if some part of the Reichsbank gold, if not all, has not already found its way into the statements of Table 3.
- 15) The performance of the various provinces is presented in table form in Technical Information Paper No. 2, p. 3 and 4.
- 16) For 1976, the U.S. statistics reported on forty-six gold producing countries and fifty-three the ABMS, Non-ferrous Metal Data, 1978, New York, N.Y.
- 17) Source of statistics: see Table 6.

- 18) Since substantial gold sales at \$ U.S. 35. were undertaken by the International Monetary Fund, these figures for 1978 and 1979 can be counted on to include the Canadian part from her gold tranche which would have to be included as an export of gold metal. This means that care is to be taken not to interpret these gold metal export figures for the years 1978 and 1979 too literally. Cf. Table 11, p.29.
- 19) A number of economic explanations for this are possible: (a) the ore was of such inferior quality that it was not worth its refining in Canada; (b) it may have been sold by suppliers too distant from Canadian refineries to be shipped to such a Canadian location; (c) the ore may have been of an environmentally unsafe quality of little concern to the final customer; (d) since the number of gold mine operators is increasing sharply but not the proper sales expertise, new gold producers may have had to take a most willing buyer for their ores.
- 20) J.M. West, "Gold", Mineral Facts and Problems, supra, n.4. op. cit., p. 440.
- 21) The article of J.M. West follows the general tradition of using ounces as standard of measure, from which this report differs by discussing quantities in metric tons and price per ounce.
- 22) International Minerals/Metals Review, 1980, McGraw-Hill Publications, New York, N.Y., p. 64-66.
- 23) D.A. Etheredge. "Gold, extreme volatility is now a common feature of the market", Engineering and Mining Journal, March 1980, p. 120.
- 24) The Elandsrand project which cost \$220 million in 1975 would have cost \$600 million in 1980. Cf. Terry Mendenhall, "Annual 700/t Level seen until 1987", American Metal Market, vol. 88, No. 20, January 30, 1980.
- 25) Ibid.
- 26) International Mineral/Metals Review (IMMR), 1980, p. 167.
- 27) Mendenhall, loc. cit.
- 28) ABMS, Non-ferrous Metal Data, 1979, New York, N.Y., p. 178.
- 29) IMMR, 1980, p.
- 30) J.M. West, loc. cit.

- 31) IMMR, *ibid.*
- 32) Engineering and Mining Journal, January 1981, p. 73.
- 33) In recent years, the government of the United States has added several million ounces of gold annually to the international gold market through bullion sales from the treasury. These sales started in May, 1978. A similar operation was launched by the International Monetary Fund to support the finances of the less developed countries while at the same time attempting to demonetize international gold. The U.S. Department of the Treasury continued through 1979 the monthly bullion sales which began in May 1978, by offering 1.5 million ounces per month for the first four months and 0.75 million ounces per month for the following six months. Thereafter, the Department of the Treasury changed the size and timing of the sales at its own discretion, selling, for instance, 1.25 million ounces on November 1. The bullion was mainly purchased by European Banks and shipped from the United States. In turn, the International Monetary Fund reduced its monthly bullion auction from 470,000 ounces to 444,000 ounces, and stopped selling to member countries on a "non-competitive basis." (*ibid.*). A total of 5.46 million ounces were sold according to the referenced source (International Minerals/Metals Review) whereas the actual decrease of gold held by the IMF, according to Table 11, p. 72 is 91.92 million ounces! One reason for this obvious discrepancy is that beginning March 1979, countries (Belgium, Denmark, France, Germany, Ireland, Italy and the Netherlands) participating in the European Monetary System were issued European Currency Units (ECUs) against their deposits with the EMCF of gold and U.S. dollars. In July of 1979, the United Kingdom was also issued ECUs against its deposits with EMCF gold and U.S. dollars. For these countries, reserves deposited with the EMCF are excluded from their gold and foreign exchange holdings and all holdings of ECUs are included in foreign exchange. This is a significant increase in foreign exchange beginning March 1979, due to the inclusion of the ECU counterpart to gold deposits and EMCF's valuation of the gold deposits at a market related price. IMF, International Financial Statistics, Yearbook, 1980, p. 5.
- 34) *ibid.*, p. 388.
- 35) See M.J. West, *loc. cit.*, p. 441-443.
- 36) International Minerals, 2nd, p. 231.

- 37) "Gold Fields sees rising, volatile price movements for 1980 gold", Engineering and Mining Journal, August 1980, p. 42.
- 38) Brazil: 8,512,000 km²; Canada: 9,976,000 km²; U.S.S.R.: 22,402,000 km²; China: 9,597,000 km²; U.S.A.: 9,363 km²; South Africa: 1,221,000 km².
Source: World Bank: World Development Report 1979, Washington, D.C., pp. 126-127.
- 39) *ibid.*
- 40) Time Magazine, Sept. 8, 1980, p. 35. See also n.1, Table 8, *supra*.
- 41) IMMR, 1980, pp. 286-288.
- 42) In the summary statistics of the E&M, Jan. 1979-1981, no additional investment information is given concerning activities in gold mining in Peru.
- 43) Ref. IMMR, 1980, pp. 545-546.
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|-----|------|---------------------------------------|---------|---------|--|
| 44) | 1980 | The Manila Mining Co. | \$ 6 | million | 21,600 oz. per annum |
| | 1980 | Surigao Consolidated | \$ 7.32 | million | 154,200 oz. per annum
(for a period of
12 years) |
| | 1980 | Vulcan Industrial and
Mining Corp. | \$ 3.1 | million | 32,000 oz. approx
(if 0.2 oz/mt.) |
| | 1981 | Batong-Buhay Gold Mines | \$240 | million | 21,700 oz. |
| | 1982 | Metals Exploration Asia | \$ 20 | million | 30,000 oz. |
| | | | | | <hr/> 259,500 ounces per
annum or
8.07 metric tons |
- Source: E&MJ, January, 1980 and 1981. The dollar values of investment would appear authentic; the computation of the capacity is computed on the base of incomplete information and has to be treated accordingly.
- 45) J.M. West, *loc. cit.*
- 46) IMMR, 1980, p. 457.

- 47) The Engineering and Mining Journal, January 1981, p. 75 records one small gold mining expansion project which has not yet been finalized. It involves the Hillso Gold Co., which wants to invest \$17 million in the Old Morning Star Mine to produce 1.6 metric tons of gold per annum. Texas-gulf has recently acquired 59 leases (normally 24 acres apiece) some of which are close to areas where gold nuggets have recently been found. E&MJ, Dec., 1980, p. 9.
- 48) ABMS. Non-ferrous Metal Data, 1979, p. 109.
- 49) See supra. n. 24.
- 50) Other countries for which information was obtained but which are insignificant gold producers in the context of this study are Algeria, Egypt and the Ivory Coast. As concerns Algeria, the Algerian state mineral corporation SONAREM declared its intention to mine the gold deposits in the Hoggar region where the presence of gold had been known for some time and is believed to be commercially viable, especially after the huge rise in gold prices during the year 1980. Egypt is known to have gold ores in the Eastern desert, which are being studied by EGSO, the Egyptian Geological Survey Organization.
In regard to the Ivory Coast, gold provides the greatest hope for the output of minerals. The Consortium of d'Ity has been formed to exploit the proven though small reserves of up to 18 metric tons of gold close to the Liberian border. The break-even point is around \$220 per ounce. The operations are to be financed by the semi-state corporation SODEMI (Societe Pour le Developpement Minier de la Cote D'Ivoire).
- 51) Robert Alexander Mundell, Monetary Theory, Inflation, Interest and Growth in the World Economy, Pacific Palisades, 1971, p. 166.
- 52) Fritz Machlup, "World Inflation: Factual Background," Inflation as a Global Problem, Randall Henshaw (ed.), Johns Hopkins University Press, Baltimore, 1972, p. 32.
- 53) Today, other European currencies are very active in the recycling operations. What was formerly purely the Euro-dollar market has not evolved into the Euro-currency market.
- 54) Factors cited in the neighbourhood of 7:1 are quite reasonable. Robert Collison, "The Birth of Petrobanking," Canadian Business, December, 1980, pp. 41-55.

- 55) *ibid.*
- 56) "S. Africa timing future gold sales," Globe and Mail, July 8, 1980, B 13.
- 57) See, e.g., R.A. Mundell, *op. cit.*, p. 73.
- 58) See James J. McRae, "On the Stability of non-replenishable Resource Prices", Canadian Journal of Economics, vol. xi, No. 2, Supplement, May 1978, pp. 287-299.
- 59) Government of Canada, Emergency Gold Mining Assistance Act, R.S.C. 1970, E-5, p. 2559-2570; the assistance rate is specified under (s.2 (1.b)) as "two-thirds of the amount by which the average cost of production of gold from the mine...exceeds twenty-six dollars and fifty cents, but not in any event exceeding twelve dollars and thirty-three cents". This rate is multiplied by "two-thirds of the number of ounces of gold produced from the mine and sold in that designated year...", *ibid.*, S.3 (2.a). Additional amounts were payable in the designated years 1958 to 1970 by an additional 25 percent; *ibid.*, (3); mines were excluded under the Act if the value of gold produced was less than seventy percent of the value of the output of the mine, *ibid.*, S.2 (2). Payments were only made for gold sold to the Royal Canadian Mint ((S.3 (1.a)) or was exported from Canada in the form of concentrates or are concentrates containing gold, and sold (b)).

The formula prior to 1958 was:

$$A = 0.44 Q_{Au} \left(\frac{TC}{Q_{Au}} - \$26.50 \right)$$

-1957

From 1958-1970:

$$A = 0.448 Q_{Au} \left(\frac{TC}{Q_{Au}} - \$26.50 \right) \times 1.25$$

-1958-1970

where A is the \$ amount of assistance, Q_{Au} is the quantity of gold produced during a designated year, TC the cost of production whereby the value in the bracket could not be larger than \$12.33.

